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Context and agency in urban community energy initiatives: An analysis of six case studies from the Baltic Sea Region

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ABSTRACT

In this paper, we analyse community energy (CE) projects in urban settings. Building on insights from the literature on the geography of sustainability transitions, we examine how contextual conditions promote or hinder the development of CE. Furthermore, reflecting on calls for greater attention to agency in transitions, we investigated how actors engaged in urban CE projects exploit beneficial conditions or overcome obstacles related to some of the contextual conditions. Empirically, we draw on six case studies of CE projects from the Baltic Sea Region. To develop a thorough understanding of our cases we conducted 24 semi-structured interviews and analysed numerous secondary sources. Our results show that institutions as well as visions, e.g. plans for future energy generation, are important contextual features for urban CE projects. Local actors seek to overcome unfavourable contextual conditions for CE initiatives by building trust, appealing to their community's sense of identity, networking, and promoting demonstration projects. Based on the results, we recommend that local and national governments address the following four issues to strengthen the role of CE in the transformation of urban energy systems: 1) harmonising policies; 2) creating a culture for transitions; 3) developing visions for CE; and 4) promoting policy learning from experiments.

1. Introduction

In the next few decades, global greenhouse gas emissions must decrease considerably if humanity wants to limit global warming to 2° (IPCC, 2014) or even 1.5° (IPCC, 2018; UNFCCC, 2015). Cities are carbon flow hubs (Bulkeley et al., 2013) absorbing approximately 75% of global energy production (Kammen and Sunter, 2016). Considering the urgency of climate change, it is evident that cities need to make a rapid transition towards sustainable energy systems. Technological progress is enabling new forms of urban energy production. This is exemplified by the rise of urban living labs (Evans and Karvonen, 2010; Voytenko et al., 2016), urban decarbonisation projects (Bulkeley and Castán Broto, 2013; Kristjansdottir and Busch, 2019; Madsen and Hansen, 2019), and smart- and eco-city concepts (Cugurullo, 2016; Hughes et al., 2018; Hult, 2013; Meijer and Bolívar, 2016).

Renewable energy is likely to play a major role in future urban energy systems. However, the pace of the transition towards clean energy sources in urbanized areas remains slow. Recently, the concept of community energy (CE) has attracted increasing attention both in academic and public debates for the role it may play in accelerating the energy transition. Loosely defined, CE refers to energy installations in which renewable energy is produced by and for communities (Walker and Simcock, 2012) and can take various forms in terms of ownership and governance (Ruggiero et al., 2018). Several advantages are associated with CE initiatives. Apart from lower emissions, other important advantages are increased acceptance of renewable energy technologies (Islar and Busch, 2016; Warren and McFadyen, 2010; Wirth, 2014) and economic benefits for the local population (Brummer, 2018; Busch and McCormick, 2014; Ruggiero et al., 2014). Policymakers are increasingly recognising CE's advantages. This is demonstrated by the EU's 2018 renewable energy directive, which provides support for local renewable energy communities (EUR–Lex, 2018).

As CE is a localized phenomenon, there is a need to better understand the local and higher-level factors that influence it. Many studies on CE

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have discussed the barriers to this phenomenon (Brummer, 2018; Walker, 2008), but minimal attention has been devoted to how local actors attempt to overcome such barriers. Furthermore, studies on CE have predominantly analysed projects in rural settings (Haf and Parkhill, 2017; Mundaca et al., 2018; Wirth, 2014), even if a community-based approach also has significant potential to contribute to urban low-carbon energy transitions.

This article aims to address the limited geographical focus and lack of attention to urban settings in the existing literature on CE by studying urban CE projects in the Baltic Sea region. We choose the Baltic Sea region because CE has not yet been sufficiently studied in that region. The research question we address in this study is as follows: how do actors involved in urban CE initiatives exploit or overcome contextual conditions? Our analysis was guided by the framework developed by Hansen and Coenen (2015), which highlights the role of contextual factors in sustainability transitions. This analysis allows us to arrive at an understanding of the development of urban CE, which is sensitive to contextual differences without neglecting the role of agency.

The remaining part of this paper is organised as follows: Section 2 introduces our conceptual framework. Section 3 presents the data and methods. Section 4 presents six CE cases from Denmark, Estonia, Finland, Germany, Poland and Sweden. Sections 5 and 6 provide the discussion, conclusion and policy implications.

2. Conceptual framework

2.1. The role of contextual factors in community energy development

The literature on the geography of sustainability transitions shows that transitions unfold unevenly across space; some countries take the lead in driving transitions towards more sustainable modes of production and consumption, while others trail behind (Coenen et al., 2012; Hansen and Coenen, 2015). We can observe that certain regions in countries, like Denmark, Germany and the UK, are at the forefront in the development of renewable, citizen-driven energy solutions (Simcock et al., 2018). For example, in the North Rhine-Westphalia region of Germany, a coalition of 24 municipalities is implementing an ambitious plan to become energy self-sufficient by 2050 through a CE approach (Kress, 2018).

One important explanation for geographical differences is the dissimilar preconditions that regions have for developing and diffusing CE. In other words, contextual factors can be expected to significantly influence the possibilities for developing CE. As noted by Seyfang et al. (2013), multiple external factors may influence internal factors to CE projects, such as level of skills and engagement of the participants.

Hansen and Coenen (2015) developed a framework for understanding the role of contextual factors by surveying the literature on the geography of sustainability transitions, which serves as a useful starting point, given the research question we analyse in this paper. Rather than being based on a specific theoretical perspective, the framework is constructed bottom-up by reviewing empirical papers from this literature. We follow and extend this work suggesting six categories of contextual factors that may affect CE: visions, formal institutions, informal institutions, resource endowments, technological specialisations, and socio-economic conditions. Socio-economic conditions were not included in the work of Hansen and Coenen (2015), however, it clearly emerges as an important contextual factor in the literature on CE (see below). Consequently, we add this category to the framework in our analysis. Below we elaborate on all six categories of contextual factors, as well as on their relevance to the development of CE.

Visions can be thought of as "ideal and unique image[s] of the future" (Ruvio et al., 2010, p. 145), idealized future goal states (Conger, 1999) or plans for future goal attainment (Strange and Mumford, 2005), which help to reduce uncertainty and set priorities (Nikoleris, 2018). Their role in guiding long-term societal transformation has been extensively discussed by transition scholars (Geels and Raven, 2006; Rotmans and Loorbach, 2006). Visions for the development of regional energy systems do provide legitimacy for change in a certain direction and will therefore influence the development of energy systems. They are not static and evolve over time (Hodson and Marvin, 2009). In order to succeed, visions need to be grounded in local agendas and contexts (Mcdowall et al., 2006). The processes of creating visions may be open to civil society participation, which produces diverse opportunities for wider societal engagement in energy transitions (Chilvers and Longhurst, 2016). Broader regional or national visions for the development of the energy system also influence the development of visions internal to CE projects, which in turn strengthen the sense of community and ownership of the project (Forman, 2017; Islar and Busch, 2016). Finally, visions are frequently contested and result in struggles between (groups of) actors with diverging interests (Coutard and Rutherford, 2010).

Formal institutions consist of regulations, laws and other types of policies (Mignon and Bergek, 2016) operating at different spatial scales related to the energy system. These institutions vary significantly in scope. For example, while policies at the EU and national level are clearly crucial, regional and local government actors play central roles through not only drafting regulations covering their jurisdictions but also through processes where national-level regulations are contested, interpreted, and circumvented (Coutard and Rutherford, 2010; Quitzau et al., 2012). Formal institutions differ from visions because the former are coercive, while the latter represent future images that can be used to plan a desired future. In CE development, formal institutions, such as energy regulations, have played a crucial role. Several mechanisms influencing CE have been discussed in the renewable energy policy literature (Curtin et al., 2017). Feed-in tariffs (Fleiβ et al., 2017), grants and loans (Strachan et al., 2015), and tax incentives (Mey et al., 2016) are seen as the most effective incentives in promoting CE development.

Informal institutions include traditions, customs, moral values, and all other norms of behaviour (Pejovich, 1999). As noted by Bridge et al. (2013), geographically determined cultural differences influence the development of energy systems. Thus, broader regional or national informal institutions influence the internal characteristics of CE projects. Examples of informal institutions that have been associated with successful CE initiatives are cultures of civic engagement (Radtke, 2014; Walker and Devine-Wright, 2008) and interpersonal trust (Walker et al., 2010), which indicate community cohesion (Martiskainen, 2017). Previous research on CE has linked trust to the social capital of a community and underlined its importance for CE development (Busch and McCormick, 2014; Kunze, 2011). Social capital can be understood as "the aggregate of the actual or potential resources which are linked to possession of a durable network of more of less institutionalized relationships of mutual acquaintance or recognition" (Bourdieu, 1986, p. 248). Thus, social capital refers to social networks. Narratives of the past and present can also play an important role in local sense-making and serve as constitutive elements of local identity, which in turn strengthen local informal institutions.

Natural resource endowments, for instance, in the form of regional biomass availability or wind or solar radiation, are also important for the diffusion of renewable energy solutions (Gosens, 2017). The absence of fossil resources may also incentivise investments in renewable energy to improve energy access and security (Essletzbichler, 2012). Research on CE indicates that there are numerous instances of projects being performed in regions that are rich in natural resources. This situation is the case of community wind power in Scotland (Ruggiero et al., 2014), biomass cooperatives in Eastern Finland (Ruggiero et al., 2018), and photovoltaic (PV) in Australia (Mey et al., 2016).

Technological specialisations of regions will also influence future opportunities for diffusing energy technologies (Grillitsch and Hansen, 2019). Partly, this phenomenon follows from the tendency of place-based policies to support technology applications that build on local industrial specialisations (Smith, 2007). Furthermore, it is suggested that regional technological specialisations may also lead to knowledge spill-overs to civil society and thereby promote broader

social learning (McCauley and Stephens, 2012). The literature on CE lacks studies that have explicitly explored the influence of technological specialisation on the competence level of citizens involved in CE projects. However, the case of wind power in Denmark demonstrates the reverse relation, i.e. how citizen-driven wind power projects played a central role in developing the industrial specialisation of Denmark in wind turbine manufacturing (Simmie, 2012; Mey and Diesendorf, 2018).

Socio-economic conditions refer to factors such as the level of income or education that characterise a certain region. Some research addressing the role of socio-economic factors in CE diffusion has highlighted the role of disposable income. For instance, Magnani and Osti (2016) argued that the level of disposable income is a key factor in explaining the different levels of CE development in rural Southern Italy and Germany. In another study, Radtke (2014) found that not just high levels of income but also education, including knowledge of renewables and insight into energy issues, correlate with high levels of participation in CE projects.

2.2. The role of actors and agency in community energy development

As illustrated in the previous section, multiple types of contextual factors will likely exercise significant influence on CE developments. However, regional characteristics do not independently determine the development of renewable, citizen-driven energy solutions. Essentially, the extent to which favourable conditions are exploited – or unfavourable conditions are overcome – will also depend on the actions by local and external actors. Many of the empirical studies on sustainability transitions have been very useful in illustrating the systemic and multilevel nature of socio-technical transformation, but have often lacked sensitivity for the role of actors and agency (Farla et al., 2012). We here follow Jolly et al. (2020, p. 177) suggesting that "[w]hile agency is fundamentally concerned with actions or interventions to produce a desired effect, agents point to the actors that exercise agency". We do not a priori establish a focus on specific types of actors, which may be either individuals, groups of individuals, organisations or groups of organisations (Sotarauta et al., 2020).

In the literature on energy transitions, a number of scholars have exposed how different types of actors have influenced the contextual dimensions by following different strategies. For example, Becker et al. (2016a) show how actors influenced institutions in the context of the re-municipalisation of the energy sector in Hamburg. They find that a broad coalition of civil society actors initiated institutional change by reinstating public ownership of critical energy infrastructures by means of a public referendum. Building on the examples of re-municipalisation projects in Hamburg and Berlin, Becker et al. (2016b) show how agency is based on contextual factors such as "legal frameworks and social movement and policy traditions" (p.228) and that the outcomes of policy processes must be understood as the consequence of agency. The work of Hess (2014) and Lee and Hess (2019) highlight how grassroots coalitions, incumbent industries, and emerging industry coalitions compete for influence on the political agenda and regulations (formal institutions) through mobilisation of financial resources and discursive strategies.

Thus, the literature on energy transitions has focused on how actors (attempt to) deal within and even change contextual conditions. However, we draw on the distinction by Sotarauta (2017) between institutional entrepreneurs and institutional navigators to suggest that overcoming unfavourable conditions does not necessarily entail changing them. Drawing on Battilana et al. (2009), institutional entrepreneurs are understood as actors that initiate and implement institutional changes, while institutional navigators have no ambition of changing institutions, but rather seek "to deal with mixed messages of many institutions, and comply with them but simultaneously pursuing their own strategy" (Sotarauta, 2017, p. 592). Consequently, in our analysis of how actors overcome unfavourable contextual conditions for CE development, we pay attention to both entrepreneurs and navigators.

Specifically regarding CE, previous studies have shown that CE actors utilize their agency on multiple levels of action and stages of development to promote institutional change (Mahzouni, 2019). Research has also emphasised that actors can often play multiple and, sometimes, conflicting roles simultaneously (Ruggiero et al., 2014). Two categories of actors that have recently received notable attention in the CE literature are local champions and intermediaries. Studies have shown that local champions play an important role in developing CE projects (Seyfang et al., 2013) and in local energy and carbon reduction (Hamilton et al., 2014). Local champions are individuals who have a "prominent role in starting, endorsing or carrying out" a CE project (Ruggiero et al., 2014, p. 59). Previous research has particularly highlighted the role of neighbourhood champions in energy conservation (Parkhill et al., 2015). Local champions promote the replication of CE practices, although research seems to indicate that this process is limited to contexts that share similar characteristics (Mahzouni, 2019). Intermediaries are organisations or individuals that facilitate the exchange of information, best practices, and linking of CE projects with the "wider world" (Hargreaves et al., 2013, p. 868). According to Hargreaves et al. (2013, p. 879), CE intermediation is "about opening up space in different contexts (whether local, policy, market, social etc.) for new and diverse kinds of activity." Intermediaries cooperate with local authorities and supportive networks to connect, provide knowledge, and lobby on behalf of CE projects (Berka and Creamer, 2018). At the local level, intermediaries facilitate community engagement by orientating CE development towards the community's views and expectations. When conflicts arise, they can mediate between actors to resolve disagreements (Hoppe et al., 2015).

3. Data and methods

This study follows a multi-case study research design. Geographically we focus on the Baltic Sea Region as defined by the EU INTERREG Secretariat (European Union, 2020). This is a region with a long-standing tradition of joint action and cooperation. We conducted six case studies of CE initiatives in Sweden, Denmark, Germany, Poland, Estonia, and Finland. We selected these countries because they have different levels of CE development. For instance, Denmark and Germany have numerous CE projects, while the Baltic states have very few. Despite these national differences, all countries share a common policy framework set by the EU. The studied cases were in geographical locations that can be considered urban in Scandinavian and Baltic states. This implies that our definition of urban space ranged from small and medium-sized towns to large urbanized areas. Table 1 shows the details of the type of renewable energy technologies adopted and key actors involved in each case.

We selected our cases through a two-step process. In the first step, we asked experts from public institutions working on renewable energy from the different target countries to compile a list of possible CE cases from their countries. We recruited these experts from an ongoing EU INTERREG project on CE. The experts were mainly operating on the local or regional level, for example in regional planning offices, municipalities or energy agencies. The initial search generated a list of approximately 50 possible CE cases. As expected, certain countries had more cases, while others had only few examples of CE projects. Subsequently, we filtered all those initiatives in which renewable energy was not produced by and for local communities. To further filter the remaining cases, we applied a maximum variation sampling procedure to select CE cases with different characteristics and backgrounds. The selection criteria included the following:

1. Diversity of renewable energy sources adopted (e.g., wind, solar, biomass);
2. Broad spectrum of activities (both electricity and heat generation);
3. Scale of initiatives (both large and small projects);

Table 1
Selected CE cases.

Project ID	Name	Country	Type of technology	Actors involved
1	Housing Company in Helsinki	Finland	Solar PV	Apartment owners, a researcher, local grid company
2	Kagu Energiaühistu	Estonia	Solar PV	Municipality of Värska, a municipal company for wastewater management, an NGO, private individuals
3	Energiegenossenschaft Sprakebüll	Germany	District heating (wind/solar PV/CHP)	The mayor, citizens, a project manager
4	Housing Community in Szczecin	Poland	Solar PV	Project coordinators, energy advisors, municipality of Szczecin
5	Marstal Fjernvarme	Denmark	District heating (solar thermal/ biomass/ CHP)	Community-owned company Marstal Fjernvarme, Ærø Energy and Environment Office
6	Törneby and Nöbble Solpark	Sweden	Solar PV	Staff of Kalmar Energi, cooperative of private households and local businesses from Kalmar

4. Different organisational forms used (e.g., cooperatives, associations, housing companies);
5. Varying scales of urbanization (both small and large cities)

The second step yielded six cases of CE projects, which became the focus of this study. To develop a deep understanding of our cases, we conducted 24 semi-structured interviews (i.e., 4 interviews per case) with project leaders, politicians, representatives of energy companies, energy consultants, public servants, and municipal officers. In addition to the interviews, we also conducted field visits to the projects' sites and analysed numerous documentary sources including online media articles, regional and national statistics, and websites related to the projects. We analysed the transcripts of the interviews and the documentary data through content analysis. Before the study commenced, we developed a theory informed framework to guide the coding of the interview material and other documents. The categories used for coding the data were derived from Hansen and Coenen (2015) and the large body of studies on CE we discussed in Section 2.1 (see Appendix for a summary of these categories). The coding frame included explicit definitions and coding rules for each category. During the coding process, we systematically coded our data against all the contextual categories identified in our theoretical framework. In addition to the theoretically derived categories, we allowed other relevant categories to emerge from the raw data. The coding was carried out by multiple coders (three of the four authors) to check whether the same codes reliably applied. After coding, the data was summarised and compiled in short case studies, which we report in Section 4.

4. Results

4.1. Housing company in helsinki (Finland)

The housing company in Pikku Huopalahti (a neighbourhood of Helsinki) is taking part in a demonstration project to test the feasibility of a new IT system that allows the self-consumption of solar energy within the single apartments of the housing company. Despite the existence of demonstration projects, several external factors hinder CE projects in multi-apartment buildings. For instance, current regulation makes energy self-consumption in multi-apartment buildings not economically viable. Therefore, solar PV installations are generally used to provide electricity for only the common parts of a building (staircase lights, elevators, laundry room, etc.). In addition, although in Finland there is a tradition of communal work and cooperatives, CE projects in apartment buildings are limited due to a lack of incentive schemes.

The most important actors in the Pikku Huopalahti housing company were two people from the housing company board, a solar PV systems provider, the local grid operator, and a researcher. The owner of the company providing solar PV systems connected the members of the housing company to a researcher who made it possible for the housing company to participate in the demonstration project. The researcher was instrumental in promoting an experimental approach without which important insights about the obstacles that need to be removed to allow energy self-consumption in multi-apartment buildings would not have been gained. The researcher developed this experimental approach at a Finnish research and innovation institute, which was trying to promote a culture of experimentation within the Finnish public sector to accelerate societal transformation. The researcher applied for a special permission from the Energy Authority, Ministry of Economic Affairs and Employment, and The Ministry of Finance to experiment with the new metering system. Thanks to this special permission, the apartment owners were exempted from paying any tax on the self-generated electricity during the experimentation phase.

The relatively good income of the apartment owners favoured investment in the solar PV system. In addition, the two members of the housing company board had the stamina to persist despite the vocal opposition of some other members. They also had the ability to leverage the enthusiasm of the young apartments' owners, who wanted to actively reduce their carbon footprint. As no investment grants are available for housing companies, they had to take a separate loan for purchasing the solar PV system. In order to make the new energy self-consumption scheme work, the grid operator created a new metering system. The new metering system allows the electricity that is normally fed into the grid to be allocated to each apartment so that it reduces the energy bills of the apartment owners. The local grid operator charges a small service fee to calculate the net amount of electricity consumed by each apartment owner.

4.2. Kagu Energiaühistu (Estonia)

Kagu Energiaühistu (Kagu energy cooperative) is a unique model of a non-profit organisation operating in the South-eastern region of Estonia known as Setomaa. This region is a culturally distinct and rich region inhabited by the Seto people. Kagu Energiaühistu is not yet involved with any renewable energy projects but is completing a feasibility study for two solar farms in the town of Värska.

The most important actors in the establishment of the Kagu Energiaühistu were the mayor of the town of Värska, a municipal company for energy and wastewater management, a local NGO, and seven private individuals who had substantial experience and knowledge with renewable energy projects. These people knew each other and shared common interests. They wanted to test a new energy cooperative model that could promote solar energy in Estonia and benefit the local community.

The establishment of the Kagu Energiaühistu was favoured by an

external factor, namely, a regional plan to promote energy self-sufficiency and sustainable development. This plan was created by an umbrella organisation formed by the main municipalities in the region and served as a guiding vision. The umbrella organisation is funded by the national program for the Setomaa region. Another important external factor was the presence of a suitable legal structure that could be used to establish the energy cooperative. This model is known in Estonia as "commercial association" and is a form of non-profit organisation promoting community entrepreneurial activities. The advantage of this legal structure is that the members are not personally liable for the association's obligations. External conditions in the form of informal institutions were crucial in the establishment of the Kagu Energiaühistu. For instance, there is a long and well-established tradition of communal work in the production of handicrafts and organic food in the region. Moreover, the people in the region have a strong sense of community due to their shared identity as Seto people. In the region there have been several cooperation projects with other Seto communities from the neighbouring countries.

Although there was a plan for promoting energy self-sufficiency in the region through local renewable energy sources, there are no other solar energy cooperatives in Estonia. Therefore, the actors involved with the Kagu Energiaühistu are trying to demonstrate that citizen participation in local renewable energy projects is possible and beneficial. They would like to see citizens from any part of Estonia and even Europe be able to invest in local renewable energy projects.

Regulation remains one of the main obstacles to solar energy cooperatives in Estonia. For instance, grid connection is extremely expensive. To overcome this external obstacle the members of Kagu Energiaühistu had to choose a plot of land where there was already a suitable grid connection. Another example of regulatory barrier is the lack of investment support for energy cooperatives. However, as the current legislation supports energy self-consumption, the members of the Kagu Energiaühistu have explored the possibility of cooperatively investing with a private company who would buy the electricity generated through a power purchase agreement. Besides regulation, another important barrier is the low socioeconomic status of households that limits investment in renewable energy projects.

An interesting way that the main actors involved in the Kagu Energiaühistu have succeeded in mobilising local attention to their initiative is by exploiting a simple narrative built around the need to fight depopulation in smaller cities of Estonia through local initiatives and linking to regional politics.

4.3. Energiegenossenschaft Sprakebüll (Germany)

The Sprakebüll energy community exemplifies a technologically diverse CE model. The community has over 20 years of experience with citizen participation models. In addition to the production of wind and solar electricity, the village utilized a privately-owned biogas plant for a cooperative district heating system.

The key actors were five villagers from Sprakebüll who were especially keen on implementing the community wind farm project. Within this group, the village mayor and a project manager emerged as the main facilitators of the CE project. The project manager played a key role in educating himself on renewable energy by visiting the locations of and learning from successful regional citizen wind power initiatives, thus showing how actors can use external conditions to create internal resources. All key actors had lengthy personal contacts and wanted to contribute to the national energy transition. Moreover, the actors involved in the project had a strong identity with their region that motivated them to take actions to address depopulation by creating better socio-economic conditions in their village.

The mayor, as an established figure in the local community, played an important role in creating an open and transparent dialogue within the community. His 20 years of political experience helped gain support from the local council. He was pivotal in promoting a CE vision, which became an internal change factor leveraging the national action plan for the energy transition (Energiewende). The technological specialisation of regional energy providers in wind and solar energy meant that during the establishment phase, the project manager could take part in regional transfers of technical know-how. This strategy of tapping into external know-how laid the foundation for a strong network of personal contacts within the regional wind and solar sector, which created the opportunity to exchange and transfer the lessons learnt. This knowledge exchange gradually translated into project-based experience and eventually helped the project owner found a local solar company. In addition, favourable incentive schemes, good wind power conditions, the fact that the northern German state of Schleswig Holstein was already home to several CE initiatives, and a long-standing tradition of cooperatives, were other favourable contextual conditions.

Strict environmental laws remain one of the key obstacles for wind power cooperatives in Germany. Germany's Federal Nature Conservation Act (BNatSchG) dictates the national environmental guidelines in the protection of the environment and erection of wind turbines. Depending on the case, federal and municipal planning authorities have the power to stop renewable energy projects. In the case of Sprakebüll, the presence of sea eagles and a radar station close to the planned wind farm presented planning permission obstacles. In order to overcome these external obstacles, the project manager utilized his network of industry acquaintances and employed competent expert consultants to identify possible adaptation strategies. These strategies included the eventual modification of the wind blade shielding technology to eliminate the effects on the radar station frequencies. The flying patterns of the sea eagles hence determined the proposed wind turbine build location. The successful adaptation strategies of the project manager helped overcome local obstacles and sustain the wind farm project.

4.4. Housing Community in Szczecin (Poland)

The Pszczelna Solar Housing Community is the first community in Szczecin, Poland, to install a PV system. Current Polish energy regulation renders self-consumption in multi-apartment buildings economically impossible. Hence, the solar PV installation only provides electricity for the common parts of the building (staircase lights, elevators, parking space lights, etc.). Surpluses from the solar PV system are sold to the network operator.

The key actors were two ambitious and progressive project managers who had close contact with the housing community residents. One project manager is a long-standing resident and member of the housing association with a strong network of contacts within the local community. The other project manager contributed his knowledge of renewable energy systems to the solar housing community project. Another important actor was an energy advisor from the National Fund for Environmental Protection and Water Management in Szczecin. He provided the two project managers with information and advice, specifically regarding the legal, financial, and organisational aspects of the "Prosument Grant Programme".

The decision to establish the solar housing community was dominated by the project manager's ability to apply for grant funding from the 'Prosument Programme', which was based on the municipality's goal to promote energy self-consumption using resources from the National Fund for Environmental Protection and Water Management. Here internal and external factors aligned as the project manager's ambition to establish a low-carbon housing community matched the municipality's aim to achieve their goal of emissions reduction and increase the number of renewable energy sources.

Cultural barriers and socio-economic conditions remain the main obstacles to CE cooperatives in Poland. Cultural barriers refer to the distrust felt by Polish citizens towards cooperative and collective models of social organisation. This is due to the fact that cooperatives are negatively associated with state socialism (Beckmann et al., 2015). Furthermore, there is a general lack of interest among Polish citizens in

renewable energies due to its dependence on domestic coal. The project managers dealt with these obstacles by organising several information sessions in order to address citizens' worries and knowledge gaps regarding the solar project. In addition, they had the determination to capitalise on the enthusiasm and environmental awareness of the younger apartment owners who were interested in reducing their carbon footprint. One key socio-economic obstacle was energy poverty, which typically influences the decision of Polish citizens to not switch fuel sources. For this reason, the project managers utilized the "Prosument Grant Programme", knowing that financing would not originate from the citizens themselves.

4.5. Marstal Fjernvarme (Denmark)

The district heating system in the town of Marstal on the island of Ærø dates to the early 1960s, when two citizens started gathering support for a member-owned heat network, which led to the founding of Marstal Fjernvarme, a company owned by the local inhabitants. In the beginning, the plant ran on heating oil and supplied the roughly 2000 inhabitants of Marstal with heat. The local energy infrastructure reflects the deep-rooted tradition of consumer-owned district heating networks in Denmark and the national goal to reduce the dependency of imported fuels after the shock of the 1970s oil crises. The Danish response to the oil crises led to rising prices for different types of imported fossil fuels creating favourable external conditions for a transition to more sustainable fuels in district heating. Therefore, over the years there were several switches of the fuel used from diesel to heavy fuel oil to bio-based oils. In the early 1990s, the company introduced the idea of a solar-based heating system, and from 1994 onwards, the plant started expanding its solar component. Nowadays, the cooperative still owns the local energy infrastructure, which consists of a big solar thermal collector field, an underground water-based heat storage pit, a co-generation heat and power boiler that uses bio-based fuels, and the pipe network in the town of Marstal.

Staff from the company managing the plant played the main role in the local transition process. The company's staff developed the idea and implemented the project. However, the decision to go ahead with the project was made by the members of the cooperative, namely, the inhabitants of Marstal. The Ærø Energy and Environment Office–a local institution to support the uptake of renewable energy–played an indirect role by providing a vision for the island of Ærø as a "renewable energy island" and shaping the public perception of renewable energy amongst the inhabitants.

The biggest asset in the energy transition was the already existing district heating system, which could be used despite the fuel switches. It provided both the physical infrastructure and the social and legal institutions to implement such a project. In terms of external natural resources, the project is located in an area with good conditions for solar thermal production, but the biofuel for the co-generation heat and power plant has to be sourced from the Baltic states.

The project was one of the first of its kind, so no specific technological competences were available at the time the project was started and, thus, the project's leaders had to learn by doing. The stepwise process and the campaigns of the Ærø Energy and Environment Office helped mitigate resistance to the technology. Some obstacles concerning the financing of the project were addressed by utilizing EU subsidies and the Danish model of KommuneKredit, which helps projects access loans at preferential rates. This shows how external conditions can help overcome internal limitations.

4.6. Törneby and Nöbble Solpark (Sweden)

The Törneby and Nöbble solar parks are in Kalmar municipality, Sweden. The Törneby Solpark is the biggest collectively-owned solar PV park in all of Sweden, producing approximately 2.3 million kWhel per year. A smaller park with approximately 600,000 kWhel per year is in Nöbble. The two parks are owned by customers of Kalmar Energi, namely, a couple of businesses from Kalmar and single households from all over Sweden. Each member can only buy panels that correspond to 80% of their own consumption to avoid concentration of ownership and enable inclusion of many households and local entities. The electricity from the parks is fed into the grid, and electricity bills of the owners are reduced by the amount their share of the panels contributed to the total output. The project has helped to create a strong local brand and enabled citizens and companies to become prosumers.

The staff of Kalmar Energi were the driving force behind the project and they managed to align internal drivers and external conditions for the benefit of the project. They initiated the project and now manage it as a service contractor. The group of investors is comprised of the cooperative of private households and several local businesses from Kalmar, such as a local supermarket and car-dealer. The cooperative is called Kalmarsund Sol. Households from all over Sweden can join the cooperative if they are customers of Kalmar Energi. A local farmer from nearby Nöbble also played an important role in the project by offering the roof space on a newly constructed barn to Kalmar Energi to construct the first solar park. Finally, the administration of the local Kalmar Öland Airport provided the space for the larger Törneby solar park.

In Kalmar external conditions and internal factors enabled the success of the CE project. The city is one of the prime locations in Sweden to produce photovoltaic electricity, and the project developer from Kalmar Energi already had 30 years of experience working on CE projects. In addition, the company could rely on a broad customer base, good relations with the local population, and close collaboration with local business partners. Potential investors were greatly interested in the project. This interest is important, as buying shares in Kalmarsund Sol is not an exceptionally good financial investment. However, buying shares was an easy way for households to become prosumers. This indicates that environmental concerns have become a general trend in Swedish society, which turned out to be a beneficial contextual factor. A further internal factor was the development of the "Energirepubliken" (the Energy Republic) campaign by Kalmar Energy. This campaign aimed at rallying up the local population behind the goal of a local renewable energy transition by playing on the idea of a movement that instils the identity as a "green prosumer" in the people involved in the project.

The biggest obstacle for the project was the lack of suitable space. The staff of Kalmar Energi overcame this obstacle by seizing opportunities in the form of the new development in Nöbble and the offer from the airport administration. Furthermore, the project team ran a successful advertisement campaign in print and social media. In addition, public events, like the opening party of the Nöbble solar park, served as opportunities to inform interested customers. Finally, the staff of Kalmar Energi used another external condition to their advantage by tapping into available subsidies (Solcellsbidrag) from the Swedish state. This subsidy is available to all kinds of investors who invest in solar panels, and it covers up to 20% of the initial investment costs. While the subsidy given by the government was helpful, it did not play a decisive role in the project.

4.7. Results of the comparative case study analysis

Table 3 shows the contextual conditions that CE actors considered favourable (+) and/or unfavourable (−) in each case study. In most of our cases, the main contextual conditions favouring CE actors were institutions, visions and resource endowments. Formal institutions were in five cases favourable contextual conditions and in all the six cases a barrier. Five out of six cases show that CE actors could leverage visions. These visions emerged because of regional planning, ambitious political goals, social entrepreneurship, or corporate strategy addressing environmental concerns. In the case of Kalmar, the municipal energy company wanted to show that it was not just "sitting back" but promoting the transformation of the local energy infrastructure through citizen participation. This was a deliberate corporate strategy to maintain

Table 3
Synthesis of the case studies (For case ID see Table 1).

Contextual Conditions	Cases											
	1		2		3		4		5		6	
Visions				+		+		+		+		+
Formal institutions	-		-	+	-	+	-	+	-	+	-	+
Informal institutions		+		+		+	-			+		+
Resource endowments						+		+	-	+		+
Technological specialisation						+		+		+		
Socioeconomic conditions		+	-				-					+
Other							-				-	

customer loyalty, which, however, reflected general environmental concerns in Swedish society. Therefore, in the case of Kalmar the vision for the CE project emerged as the result of a process of alignment between corporate strategy and citizens' desires for a clean energy future. Whereas it is not surprising that actors could take advantage of resource endowments and formal institutions, such as economic policy instruments (e.g., grants, subsidies, or loans at a preferential rate), in more than half of the cases informal.

Institutions were also important. Examples of informal institutions included tradition of cooperatives, regional cooperation, civic engagement, environmental values, social capital, and narratives. Narratives refer to the actors' attempts to build momentum behind their initiatives by positioning them within certain discourses such as the need to avoid rural-urban migration. This strategy was found in the Kagu Energiaühistu case where the local actors exploited the existing narrative about the need to create local economic development to address depopulation. Informal institutions were an important barrier in the Polish case due to the fact that collective ownership is negatively associated with the socialist period. In the Estonian case, although the informal institutions of the Setomaa region were supportive, in the rest of the country there is as much resistance to a collective ownership model as in Poland.

Resource endowments was a supportive contextual condition in four cases. In the Danish case, the lack of natural resources (biofuel) was an unfavourable condition that local actors had to overcome. Regional technological specialisation was a prominent contextual condition in two cases. Socioeconomic conditions were a positive factor in two of the countries from the west side of the Baltic Sea region, whereas for the two countries on the east side they were an unfavourable condition. The category *Other* includes factors that were not contemplated in our theoretical framework. One unfavourable contextual condition in this category was the lack of information and awareness about the possibilities and benefits of CE projects. In one case, this issue was overcome through door-to-door communication and meetings to which renewable energy experts were occasionally invited. In addition to our categories, we found that windows of opportunity are an important enabling mechanism. Windows of opportunity refer to the concurrent alignment of favourable conditions that actors can take advantage of at a specific point in time. For example, Kalmar Energi was the first company that offered an easy and affordable way for its customers to become prosumers. Therefore, they could attract many people who wanted to invest in renewables for environmental reasons.

5. Discussion

The case studies above underline the importance of institutions and visions as significant contextual conditions for urban CE development. The case studies indicate that on the west side of the Baltic Sea region informal institutions may be more favourable than on the east side underscoring the different historical legacies of the Baltic states. As it could be expected, resource endowments were often a positive contextual feature, but the Danish case shows that successful CE projects can be run even with limited natural resource endowments.

5.1. Strategies for overcoming unfavourable contextual conditions

The case studies also indicate that CE actors use different strategies to deal with unfavourable contextual conditions. Based on the combination of various contextual elements, we identify a typology of strategies adopted by CE actors to deal with unfavourable contextual conditions. In doing so, we follow Sotarauta (2017) who suggest that overcoming unfavourable conditions does not necessarily entail changing them and, therefore, one can distinguish between institutional entrepreneurs and institutional navigators. We name the identified strategies *build trust*, *appeal*, *network,* and *demonstrate*. They are not mutually exclusive as more than one strategy can be adopted at the same time.

5.1.1. Build trust

In contexts with both unfavourable informal institutions and low socioeconomic conditions (e.g. energy poverty), CE actors may adopt a strategy to *build trust* within the community. This strategy is supported by the fact that research has found that trust is an important determinant of willingness to participate in CE projects (Kalkbrenner and Roosen, 2016). The case of the Housing Community in Szczecin shows that although some favourable formal institutions may exist these are not enough to steer widespread CE development when there are weak informal institutions. In former socialist countries, there is mistrust towards CE initiatives (Capellán-Pérez et al., 2020). For instance, in Poland, the cooperative model of social organisation is associated in the minds of people with the state socialism promoted by the communist regime before 1990 and, therefore, is a major obstacle to CE development (Bauwens et al., 2016). To overcome distrust, the leaders of the Housing Community in Szczecin tried to build a stronger sense of community and address the concerns of the residents through an open dialogue. Moreover, they tried to communicate effectively the economic benefits of the project (i.e. reduced energy costs and increased property value) to the members of the housing community. With reference to Sotarauta (2017), CE actors that follow a *build trust* strategy can be considered institutional entrepreneurs as they seek to change informal institutions at the level of the CE project. However, this may in some cases instigate wider institutional change, beyond the project itself. As trust is functional to CE development (Walker et al., 2010), CE leaders should aim at building trust within their communities to foster cooperation and commitment.

5.1.2. Appeal

In contexts in which there are favourable informal institutions and guiding visions, but socioeconomic conditions may not be favourable, (e.g. in less urbanized areas), CE actors may follow an *appeal* strategy to promote support for an initiative by leveraging or crafting a community identity (Battilana et al., 2009). This strategy was particularly exemplified by the Kagu Energiaühistu case. There, a strong sense of locally bound and ethnically distinct identity was crucial in mobilising resources. One of the interviewees from the case clearly stated, "(T)his is not Estonia," expressing that the local cultural milieu was profoundly different from that of the rest of the country. Similar but less radical

notion of local identity surfaced in Ærø, where the local community framed the island as one of the Danish "Energy Islands". Both cases show the relevance of place-based identity, for strategies that appeal to communities of place. This strategy resonates with previous research that underlined the beneficial role of a sense of identity in local energy transitions (Islar and Busch, 2016). In the case of Kalmar, the local energy company was able to establish a community of interest identified with "green prosumerism". People from all over the country joined the project to become prosumers in a convenient way even though buying shares was not an overly attractive economic decision. These examples indicate that appealing to the identity of people who could potentially participate in a CE project can be a powerful mobilising tool in different settings. Following Sotarauta (2017), an *appeal* strategy is considered navigational, as actors attempt to use available resources to overcome unfavourable socio-economic conditions. Community groups living in less urbanized areas should carry out an *appeal* strategy to leverage sense of local identity. Public, civic or private organisations can also utilize this strategy to mobilise citizens who are identified with green prosumerism or want to support the energy transitions through communities of interest.

5.1.3. Network

In the presence of favourable informal institutions and technological specialisation (e.g. an established wind power industry) a further strategy that CE actors can employ to overcome unfavourable contextual conditions is *network*. This strategy is based on the exploitation of social capital. Whereas the strategy of building trust was about strengthening the sense of community, networking refers to the use of contacts with external actors to access specific resources such as know-how. This was evident in the case of the Sprakebüll village. Local CE actors used their social capital to capitalise on the regional technological specialisation in wind energy. The adoption of a *network* strategy to overcome unfavourable contextual conditions is in line with Fischer and Newig's (2016) review paper on the role of actors and agency in the literature on sustainability transitions. In their own words, they found that "the positive trend of the term 'network/s', which we discovered in our quantitative analysis, demonstrates that it is crucial for different actors to link up for solving current problems" (p. 15). A *network* strategy can be associated with the work of institutional navigators because it aims at mobilising social capital to overcome unfavourable formal institutions, without the ambition of actually changing the institutions (Sotarauta, 2017). The case of the Sprakebüll village shows that networks need to be built especially between community groups and organisations that can provide them with key resources such as know-how and technological solutions. Scholars have pointed out that local authorities, businesses and other community groups can help fill resource gaps (Seyfang et al., 2013).

5.1.4. Demonstrate

Another strategy that CE actors can pursue to change unfavourable contextual conditions is *demonstrate*. This strategy aims to change unfavourable contextual conditions through demonstration projects and experimentation. A *demonstrate* strategy may be useful when informal institutions are favourable but formal institutions (e.g. unsuitable regulatory frameworks) are unfavourable. The housing company case in Helsinki and the Kagu Energiaühistu, are good examples of this strategy. The concept of experimentation is central in various strands of socio-technical transition literature, including strategic niche management (Kemp et al., 1998) and transition management (Rotmans et al., 2001). Moreover, studies on urban transition labs (Nevens et al., 2013) and grassroots innovation (Seyfang and Haxeltine, 2012) build extensively on the concept of experimentation. Several scholars acknowledge that the main purpose of experimentation is learning (Kivimaa et al., 2017). However, for experiments to prompt (or accelerate) socio-technical change, learning should generate "new insights not only into the solutions to a certain problem but also into the problem itself and the context in which decisions take place" (van de Kerkhof and Wieczorek, 2005, p. 735). In the cases explored, there was little evidence of policy-oriented learning from experimentation, which highlights the need for a better transfer of lessons learned from experiments to policy making. Similarly to the first strategy, CE actors adopting a *demonstrate* strategy are institutional entrepreneurs (Sotarauta, 2017). The difference lies in the fact that in this strategy they aim at changing formal institutions, whereas in the first they focus on informal institutions. The *demonstrate* strategy partially overlaps with the *appeal* strategy as ultimately demonstration projects aim at appealing to the larger public that supports the energy transition. However, *appeal* and *demonstrate* strategies remain different because the first leverages a sense of identity.

5.2. Key actors in urban CE projects

Besides showing some ways through which local CE actors exercise their agency to deal with unfavourable contextual conditions, this paper highlights the role of some key actors in urban CE initiatives (i.e., municipalities, local energy companies, and intermediary organisations). The cases highlight that a range of actors play important roles in the transition processes. They also underline that these roles can considerably differ in the degree to which they get involved. For example, intermediaries can remain external actors and merely facilitate the process or they can be an active player of the community.

The case of the Housing Community in Szczecin shows that the municipality of Szczecin created a local funding scheme under a national grant program to support "prosumption" in multi-apartment buildings. This action highlights the important role that municipalities have in promoting urban CE initiatives through dedicated funding programs.

Another important actor in urban CE projects is local energy companies. The case of the Törneby and Nöbble solar parks illustrates that forward-looking municipal energy companies should not see CE projects as a threat to their profitability but rather as an opportunity. The remarkable reduction in the cost of solar PV systems will lead more households to adopt this disruptive technology. Therefore, local energy providers need to rethink their business models to accommodate an increasingly more active role of prosumers. The case of the Törneby and Nöbble solar parks also helps us to reflect on the different meanings that CE can assume in urban contexts. Citizens living in large cities do not have the same availability of space and natural resources that people living in less densely inhabited places can have. Therefore, local energy companies can play an important role in offering opportunities for citizens to invest in renewable energy projects. The case also helps us to move from the predominant idea of CE as a community of place (i.e., rooted in a specific geographical location) to the more flexible idea of a community of interest, in which citizens from different places can participate.

The crucial role of intermediary organisations was evident in the case of Marstal Fjernvarme. The data from that case confirm that of previous research by Berka and Creamer (2018), Hargreaves et al. (2013), Hoppe et al. (2015), Kristjansdottir and Busch (2019) and Ruggiero et al. (2014), who observed that intermediary organisations support CE development by connecting people, providing knowledge, and brokering and mediating between different actors. In Marstal, the Energy and Environment Office was an intermediary actor who positively influenced the inhabitants' attitude towards renewable energy.

5.3. Limitations of the study and future research

Although this paper offers valuable insights on the contextual conditions that favour urban CE development and the strategies adopted by CE champions to overcome barriers (e.g. lack of adequate regulation, low levels of disposable income, and distrust towards the cooperative model and technology), it has some limitations. First, our research design was based on a limited number of cases. Therefore, the validity of our findings should be evaluated in light of what Yin (2003, p. 31–33)

calls "analytic generalization". Second, our theoretical framework (Hansen and Coenen, 2015) is inductive as the authors created it on the basis of a literature review. We sought to overcome its limitations and increase its explanatory value by adding a new category, socioeconomic factors, but other factors that are not discussed in the CE literature may also be relevant. Third, we did not have sufficient data to explain the entire visioning processes and the role of key stakeholders at different stages of the process. Initially, visions can be volatile but with time, they can crystallize into elements of the contextual framework. Therefore, future studies could focus on how the crystallization and evolution of visions occurs and how it contributes to the institutionalisation of CE practices in urban areas (Parkhill et al., 2015). Lastly, we highlighted the role of informal institutions in hindering CE development in two post-socialist countries, Estonia and Poland. However, this phenomenon needs a more nuanced understanding (see also Hewitt et al., 2019). Therefore, further research should be performed to better understand the cultural determinants of CE. As most of the literature on CE has focused on initiatives in pioneering countries like Germany, Denmark, the UK, the Netherlands, and Belgium, research on CE in eastern and southern European countries would be particularly valuable.

6. Conclusions and policy implications

The aim of this study was to examine how actors involved in urban CE initiatives exploit or try to overcome the contextual conditions under which they conduct renewable energy projects. Expanding the framework developed by Hansen and Coenen (2015) by integrating socio-economic conditions to guide our analysis, we conducted six case studies of CE initiatives from Sweden, Denmark, Germany, Poland, Estonia, and Finland. The results show that institutions (formal and informal) and visions are essential contextual conditions. Formal institutions include grants, subsidies, and loans at preferential rates. In addition to these formal institutions, local CE actors also capitalise on informal institutions, such as the tradition of cooperatives, regional cooperation, civic engagement, environmental values, social capital, and narratives. Visions for renewable energy generation, self-sufficiency, and sustainable development play a crucial role in focusing actors' actions and mobilising resources. They emerged as the result of regional planning, ambitious political goals, social entrepreneurship, and corporate strategy responding to environmental concerns.

Although institutions are relevant factors in the development of urban CE initiatives, they are also two of the most recurrent barriers for CE projects. This phenomenon is particularly true for formal institutions, which were the main barrier to CE development in all the investigated cases. However, local CE actors do not remain idle but try to use their agency to overcome unfavourable contextual conditions. They can use four strategies: 1) build trust, 2) appeal to a community identity, 3) network to gain critical resources, and 4) promote demonstration projects. The study also highlighted the special role of three types of actors in urban CE initiatives, namely, municipalities, local energy companies, and intermediary organisations. Along with citizens, these actors can play an important role in reshaping urban energy systems.

The results of this study have four important policy implications for sustainable urban energy systems. First, in the studied countries, formal institutions like energy market regulation and policy instruments still appear largely inadequate to promote the participation of citizens in urban renewable energy initiatives. This is relevant considering the objectives of the recent EU Renewable Energy Directive, which aims to put EU citizens at the centre of the energy transition (EUR-Lex, 2018). EU member states need to implement more supportive policies and regulations to strengthen the CE sector in the EU. This study demonstrates that in the case of housing communities both in Finland and Poland, discriminatory taxes, inadequate metering regulation, slow building permits, and grid connection procedures limit the potential of energy self-consumption in multi-apartment buildings. Therefore, if such regulations are not adequately changed, then energy self-consumption in apartment buildings will remain limited to covering only the needs of the common parts of buildings and exclude the apartments in which people live.

Second, informal institutions are highly important. City governments and regional authorities, especially in the eastern Baltic Sea region should not focus merely on economic incentives to promote CE initiatives, but actively promote cultural change as well. Cultural change can be promoted by supporting and recognising good examples of urban CE initiatives, fostering social networks, and supporting independent intermediary organisations, which can act as trustworthy facilitators.

Third, along with supportive policies and regulations, national and regional governments need to develop alternative visions to guide, inspire, and mobilise different actors and resources at the city level. The recent EU Renewable Energy Directive provides a wider frame for such visions to emerge on the national level. However, these visions need to reflect cultural norms just as much as resource endowment of the different countries. A vision that does not match available resources or stands in stark contrast to citizens' understanding of their community cannot be translated to the local context where CE projects are taking place. Such misfit visions will not result in a significant beneficial impact for the transformation of urban energy infrastructures. In the absence of national visions, regional actors should establish visions on a sub-national or even trans-national level.

Fourth, one of the strategies employed by local CE actors to overcome unfavourable contextual conditions is demonstration. These initiatives have the potential of creating insights that help identifying and changing unfavourable regulations. To achieve this goal, lessons learned from urban experiments and pilot projects need to be implanted into policymaking and in institutional change processes. Consequently, experimentation should be carried out with the aim to provide insights on how to adjust the legal framework that prevents citizens from taking an active role in local energy transitions. Urban experiments that have explicit policy learning goals should be prioritised over experiments aiming merely at technological development.

Our research shows that CE has potential in the Baltic Sea region. This finding holds true even in places where specific contextual conditions limit the diffusion of CE initiatives. In order to promote the augmentation of CE in urbanized and other areas, policy changes in line with those we discussed in this article will have to be introduced. With the Renewable Energy Directive, the EU has taken an important step to transform the continent's energy system. However, it remains to be seen if the Member States will indeed provide an adequate policy framework to allow CE to flourish and benefit the local people and the climate.

CRediT authorship contribution statement

S. Ruggiero: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Supervision, Validation, Visualization, Writing - original draft, Writing - review & editing. **H. Busch:** Formal analysis, Investigation, Validation, Writing - original draft, Writing - review & editing. **T. Hansen:** Formal analysis, Validation, Writing - original draft, Writing - review & editing. **A. Isakovic:** Formal analysis, Investigation, 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.

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Appendix

Thematic categories based on the work of Hansen and Coenen (2015).

Categories	Description
Visions	These are descriptions of how a country, region or local community could develop in the future. Visions provide the focus for action and can be or co-developed by citizens, businesses, and governments (local or national).
Formal institutions	These are laws, policies, and regulations enforced by official authorities. Direct examples are renewable energy policies, regulation, the energy market, and the way a country is politically organised.
Informal institutions	These are the unwritten rules (e.g., social norms, customs, or traditions that shape people's thoughts and behaviours. High levels of trust, cohesion, and collaboration (i.e., high social capital) are other examples of informal institutions.
Natural resource endowments	This category refers to the set of natural resources (e.g., good wind resources or biomass) that some places may have.
Technological specialisation	This category refers to the concentrations in skills and competencies related to certain specific technologies. Examples are production, installation, and servicing of renewable energy technologies.
Socio-economic conditions	This category refers to general characteristics of a certain population, such as the level of income and education.

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