Community Investment and Social Acceptance of Wind Energy

DISSERTATION
of the University of St.Gallen,
School of Management,
Economics, Law, Social Sciences,
International Affairs and Computer Science,
to obtain the title of
Doctor of Philosophy in International
Affairs and Political Economy

submitted by

Jakob Knauf

from

Germany

Approved on the application of

Prof. Dr. Rolf Wüstenhagen

and

Prof. Patrick Devine-Wright, PhD

Dissertation no. 5292

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The University of St.Gallen, School of Management, Economics, Law, Social Sciences, International Affairs and Computer Science, hereby consents to the printing of the present dissertation, without hereby expressing any opinion on the views herein expressed.

St.Gallen, October 21, 2022

The President:

Prof. Dr. Bernhard Ehrenzeller

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Konstanz, January 2023 Jakob Knauf

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List of Abbreviations and Symbols[1]

Abbreviations

°C	Degree Celsius
CBC	Choice-based conjoint analysis
Cent/kWh	Cents per kilowatt hour
EEG	German Renewable Energy Sources Act (Erneuerbare-Energien-Gesetz)
EUR	Euro
GWh	Gigawatt hour
H	Hypothesis
km	Kilometer
MWh	Megawatt hour
m	Meter
PV	Photovoltaic

[1] Please note that relevant abbreviations are introduced within each paper.

Abstract

The Paris Agreement aims to limit the global increase in average temperature to below 2 °C. Replacing fossil fuels in the energy system with renewables is an important element of achieving this goal. Energy scenarios show that onshore wind energy will play a central role in this. According to the scenarios, the climate targets of the Paris Agreement cannot be achieved at the current annual rate of wind energy expansion.

Onshore wind energy is a market-ready technology. Its rate of expansion depends strongly on the acceptance of residents. In previous research, financial participation of residents has been identified as a factor that can promote acceptance. However, there are also empirical studies that have found the opposite effect.

This dissertation builds on these contrasting empirical findings. I use three academic papers to examine how financial participation of residents is related to the acceptance of onshore wind energy. Policymakers and industry actors can use the findings of this dissertation to modify the preconditions for the development of wind energy.

In the first paper, I examine how a discounted electricity tariff, payments to municipalities, and payments for social purposes are related to community acceptance. Using an online survey with a choice experiment, I show that for the majority of residents all three of the participation options have a positive effect on community acceptance. Opponents of wind energy cannot be convinced through financial participation.

For the second article we interviewed project developers who offer residents the opportunity to invest in wind energy projects. We used semi-structured interviews to investigate why, when, and how project developers do this. We show that they offer financial participation mainly to increase community acceptance rather than for financial motives. They use a staged approach to achieve this goal.

In the third paper, we use a literature review to examine how the opportunity to invest in a local wind energy project is related to community acceptance. We show that most empirical studies find a positive relationship between these factors. To achieve this effect, trust and finding a balance between risk and control are needed. Simply offering an investment opportunity does usually not fulfil this precondition.

Zusammenfassung

Das Übereinkommen von Paris soll den weltweiten Anstieg der Durchschnittstemperatur auf unter 2 °C begrenzen. Der Ersatz von fossilen Energieträgern im Energiesystem durch Erneuerbare Energien ist ein bedeutender Baustein für das Erreichen dieses Ziels. Energieszenarien zeigen, dass Windenergie an Land hierbei eine zentrale Rolle einnimmt. Die Klimaziele des Übereinkommens von Paris können bei der derzeitigen jährlichen Ausbaugeschwindigkeit der Windenergie laut den Berechnungen nicht erreicht werden.

Die Windenergie an Land ist eine marktreife Technologie. Ihre Ausbaugeschwindigkeit hängt stark von der Akzeptanz der Anwohnenden ab. Die finanzielle Beteiligung der Anwohnenden wurde in vorausgegangenen Veröffentlichungen als ein akzeptanzfördernder Faktor identifiziert. In der Literatur gibt es jedoch auch empirische Untersuchungen, die den gegenteiligen Effekt fanden.

Diese Dissertation baut auf den gegensätzlichen empirischen Ergebnissen auf. Ich untersuche anhand von drei wissenschaftlichen Beiträgen, wie sich die finanzielle Beteiligung der Anwohnenden auf die Akzeptanz von Windenergie an Land auswirkt. Personen mit politischer Entscheidungsbefugnis und Agierende aus der Industrie können die Erkenntnisse dieser Dissertation nutzen, um Voraussetzungen für den Zubau zu ändern.

Im ersten Beitrag untersuche ich, wie sich ein vergünstigter Stromtarif, Zahlungen an Gemeinden und Zahlungen für soziale Zwecke auf die Akzeptanz der Anwohnenden auswirkt. Anhand einer Online-Umfrage mit einem Auswahlexperiment zeige ich, dass sich alle drei untersuchten Beteiligungsmöglichkeiten positiv auf die Akzeptanz der Mehrheit der Anwohnenden auswirkt. Die Personen, die der Windenergie ablehnend gegenüberstehen, lassen sich mit finanzieller Beteiligung nicht überzeugen.

Im zweiten Beitrag befragen wir Personen aus der Projektentwicklung. Sie bieten Anwohnenden die Möglichkeit an, sich durch Investitionen finanziell an den Windenergieprojekten zu beteiligen. Wir untersuchen anhand von semistrukturierten Interviews, warum, wann und wie Projektierer dies machen. Wir zeigen, dass sie die finanzielle Beteiligung hauptsächlich zur Steigerung der Akzeptanz anbieten und nicht aus finanziellem Motiv. Sie nutzen einen mehrstufigen Prozess, um dieses Ziel zu erreichen.

Im dritten Beitrag untersuchen wir anhand einer Literaturübersicht, wie sich die Investitionsmöglichkeit in ein lokales Windenergieprojekt auf die Akzeptanz der Anwohnenden auswirkt. Wir zeigen, dass die meisten empirischen Untersuchungen einen positiven Zusammenhang finden. Um diese Wirkung zu erreichen, benötigt es Vertrauen und eine Balance zwischen Risiko und Mitspracherecht. Das alleinige Anbieten einer Investitionsmöglichkeit erfüllt diese Voraussetzung meist nicht.

Introductory Chapter[2]

1. Background and research motivation

The Paris Agreement on climate protection pursues the goal of keeping global warming below 2 °C and possibly limiting it to 1.5 °C (Intergovernmental Panel on Climate Change, 2022). Energy production, processing, transport, conversion, and use are some of the main sources of carbon emissions (Wilson et al., 2012). Increasing energy efficiency, reducing energy demand, and expanding the use of renewable energy sources are ways to reduce them (International Renewable Energy Agency et al., 2018).

Many governments have joined the Paris Agreement, stating that they will work toward limiting climate change by aiming to create low-carbon energy systems. This pledge creates pressure to reduce carbon emissions fast (Falkner, 2016).

For Germany, which is the geographical focus of two of the three papers in this dissertation, renewable energy and the expansion of its generation capacity are central to its national climate change strategy (BMU, 2021). Wind energy is one of the market-ready renewables on which the national strategy of the former relies heavily (BMU, 2021). The strategy projects 2,900 megawatts (MW) of new onshore wind capacity, 2,500 MW of photovoltaic (PV) and 500 MW (and rising) of offshore wind power each year through 2030, with the share of renewables expected to increase to 65 percent by 2030 (BMWi, 2020). These targets were recently increased to 10,000 MW of new wind energy capacity annually (BMWK, 2022). The political targets make onshore wind the most important source of renewable electricity generation.

However, the current trend in annual new wind energy capacity is not consistent with the plans of the climate change mitigation strategy. Figure 1 illustrates the annual newly installed generation capacity in Germany from 2000 to 2019, showing an increase until 2017. There was a sharp drop in 2018 and 2019. Since then, the capacity of new installations has grown only slowly, but has not reached the targets of either 2,900 MW (by 2022) nor 10,000 MW (from 2023).

[2] Note that the introductory chapter introduces and summarizes the three papers of this doctoral thesis. Thus, several sections draw on the content of Paper 1, Paper 2 and Paper 3 without explicit citation.

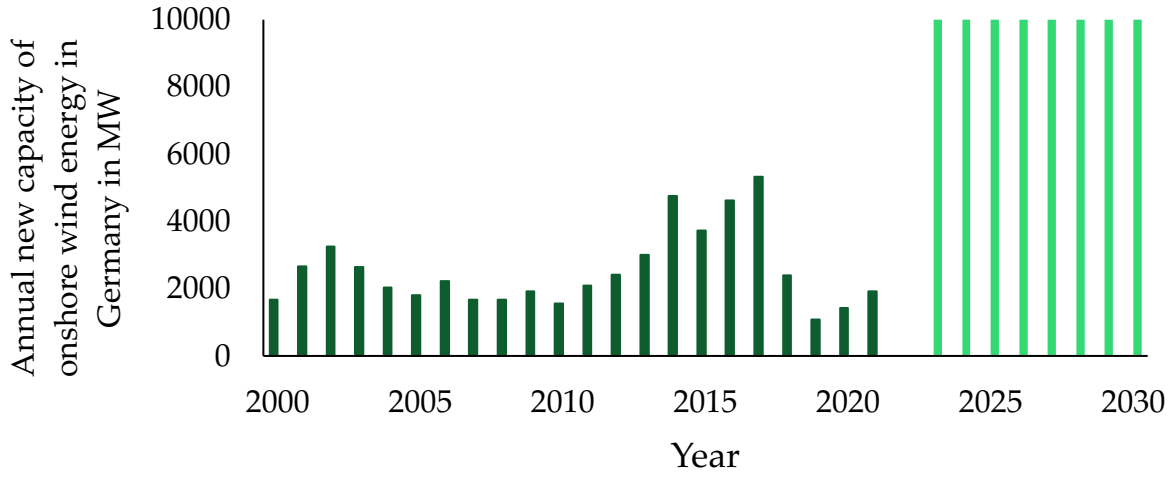

Figure 1: Annual realized new capacity of onshore wind energy in Germany, and plan according to EEG 2023. According to the new targets, yearly capacity should increase to 10,000 MW (light green) (Author's graph based on historical data from Deutsche WindGuard (2021)).

Limited available land, lawsuits, and a lack of permits are responsible for the relatively small amount of new installation capacity in Germany (FA Wind, 2019, 2022). Most lawsuits are initiated by environmental groups (61%), followed by individuals (36%), citizens' groups (14%), and associations (12%) (FA Wind, 2019). While some of the problems are based on land-use issues and land-use conflicts (e.g., protected natural areas, rotary beacons, and the military use of airspace), others are due to social acceptance issues.

The concept of social acceptance refers to the empirical finding that some technological innovations, although ready for the market and associated with strong approval in opinion polls, are not adopted quickly (Wolsink, 2000; Larson and Krannich, 2016). The concept covers three different components: socio-political acceptance, market acceptance, and community acceptance (Wüstenhagen et al., 2007). Community acceptance concerns how citizens living close to turbines perceive the projects, which is of great relevance to siting decisions.

Strong community acceptance does not guarantee the success of individual projects (Horbaty et al., 2012). However, it can increase the likelihood of the latter and simplify project processes through fostering the availability of land, reducing lawsuits, and speeding up permitting processes, ultimately affecting the number of turbines that can be built (Olsen, 2010). Therefore, increasing community acceptance is a concern for policymakers and wind industry stakeholders when seeking to expand the annual number of new turbine capacities.

The perception of the fair distribution of costs and benefits between project developers and local communities is one factor that can increase community acceptance (Wolsink, 2007; Dimitropoulos and Kontoleon, 2009). Walker et al. (2014) found that citizens perceive that wind energy is associated with high personal costs which the latter, as members of the local community, have to bear, while stakeholder outside the local community profit from energy sales. One option is for wind turbine owners to share revenues with local communities to meet citizen demands for a fair distribution of costs and benefits. (Gross, 2007; Aitken, 2010; Leiren et al., 2020). The process of financial cooperation and revenue sharing is called financial participation in this dissertation.

There are different means of financial participation (Holstenkamp, 2014; Barrera-Hernández et al., 2016; Kerr et al., 2017; McInerney and Curtin, 2017). Some models require individuals to invest in projects (Haggett et al., 2014; Beery and Day, 2015). Others involve the provision of benefits from the developer to the community (Bristow et al., 2012; van Wijk et al., 2021). Citizens may benefit as individuals, for example, by receiving discounted electricity (García et al., 2016), compensation (Aitken, 2010; Brennan and Van Rensburg, 2016) or becoming co-owners of the facilities (Shared Ownership Task Force, 2014; The Scottish Government, 2019). There are also participation models through which the community benefits on more general terms (Bristow et al., 2012; Devine-Wright and Sherry-Brennan, 2019) – e.g., through payments to a community budget, or through support for facilities that are important to the community, such as kindergartens and swimming pools (Morris, 2019).

There is evidence that financial participation can increase acceptance (Dimitropoulos and Kontoleon, 2009; Warren and McFadyen, 2010; Musall and Kuik, 2011; Hyland and Bertsch, 2018; Vuichard et al., 2022). However, negative impacts on community acceptance have also been reported in some instances (Cass et al., 2010; Walker et al., 2016; Leer Jørgensen et al., 2020). The relationship between financial participation and community acceptance is therefore ambivalent, and not fully understood yet in the scientific literature.

This thesis addresses the relationship of financial participation and community acceptance through three research papers that aim at identifying when financial participation increases acceptance, and when it does the opposite. Two of the three papers have Germany as the geographical focus. However, each paper justifies and specifies why the results are also relevant for other countries.

Paper 1 examines different financial participation models (discounted electricity tariff, payments to municipalities, and payments for social purposes) and their relationship to community acceptance. The paper first explores which model is preferred most among proponents, citizens with weak preferences, and opponents of wind energy. Second, it contributes to understanding how financial participation is related to perceived fairness.

Paper 2 examines from the perspective of project developers when, why, and how they let citizens invest in their projects. The paper takes as a starting point that citizen investment is (mostly) voluntary in Germany, and that two main forms of citizen investment are used, one involving shared ownership and voting control, the other without. The paper explores the reasons for permitting citizen investment, and second, why and how developers decide between the two different options.

Paper 3 reviews and analyzes original research papers that address citizen investment and community acceptance. The paper draws on existing empirical findings to analyze why citizen investment sometimes leads to stronger community acceptance, and sometimes to the opposite. The paper identifies opportunities for future research.

This dissertation is particularly relevant for researchers, policymakers, and project developers. For researchers, the empirical findings advance the discussion about how community acceptance and financial participation are related. Furthermore, the thesis synthesizes and shows how to further explore the field.

Policymakers can use the findings about how specific models of financial participation are related to community acceptance when developing national strategies. The findings provide concrete guidance about which model and accompanying factors should be embedded into policies aimed at increasing community acceptance and ultimately promoting the uptake of wind energy on the local level. Similarly, the findings will help project developers decide what types of financial participation models they should explore in relation to their projects.

2. Theoretical and conceptual foundations

The energy transition is disrupting how society produces, processes, transports, and converts energy (Wilson and Grubler, 2013). It involves a remarkable system change from using fossil or nuclear resources to renewables like wind, solar, and geothermal energies. However, the change is not only about technologies. It concerns society no less drastically (Ferraro and Ellis, 2017). Major changes in the energy system – a

sociotechnical system deeply embedded in society – affect individuals in different ways (Miller et al., 2013). Having been a centralized system, individuals feel changes in the energy system directly when renewable energy plants are built in previously unindustrialized areas near residents' homes (Hallan and González, 2020; Ioannidis and Koutsoyiannis, 2020). Such changes in technology and society are associated with friction and require acceptance by members of society at different levels (Stern, 2017).

2.1. Social acceptance

The concept of social acceptance describes and touches upon the willingness (unwillingness) of actors to support or even actively promote social changes within society that the adaptation of new technologies entails (Batel, 2017; Rand and Hoen, 2017). Wüstenhagen et al. (2007) conceptualize and clarify the understanding of social acceptance in three dimensions that represent three different areas of social acceptance: socio-political acceptance, community acceptance, and market acceptance. With 1,357 citations (WebOfScience, 28.07.2022), this paper is now an important starting point and reference for numerous studies.

Socio-political acceptance is the most general dimension of social acceptance. It describes the broad social and political acceptance of a renewable energy innovation (Wüstenhagen et al., 2007; Wolsink, 2018). Opinion polls illustrate that acceptance of renewable energies generally is very high in many countries (Wolsink, 2000; Larson and Krannich, 2016). For a long time, it was therefore assumed that there would be no problem with acceptance concerning the adaption of renewable energies and that the related infrastructure could be built quickly in large amounts. However, this turned out to be a fallacy. Reports of resistance on a local level to specific projects illustrate the fact that general support for a technology does not translate into acceptance of the technology at the local level (Wolsink, 2000; Bell et al., 2005; Burningham et al., 2015).

The attitudes and behaviors of local stakeholders such as residents and local authorities towards the siting of renewable energy close to their homes are associated with the dimension of community acceptance (Mjahed Hammami et al., 2018; Devine-Wright and Wiersma, 2020; Leiren et al., 2020). This dimension concerns specific siting decisions related to renewable energy projects that involve large and expensive elements of infrastructure, like wind energy (Evans et al., 2011; Walker et al., 2014; Beery and Day, 2015).

The third dimension, market acceptance, deals with the adoption of an innovation by consumers and market actors. Much of the literature in this area builds on Rogers'

(1995) theory of diffusion of innovation. In this, stakeholders like citizens are seen as consumers who, through their consumption behavior, either ensure that an innovation is adopted or not (Sovacool and Lakshmi Ratan, 2012; Tabi et al., 2014; Stauch and Gamma, 2020).

This dissertation addresses community acceptance due to its relevance to wind energy, as the siting of wind turbines in many countries like Germany is often accompanied by protest and resistance from residents (Avila, 2018). Local citizens join forces and try to make their voices heard (Blanchet, 2015) so that projects are rescheduled or abandoned. The possibility of local residents delaying or stopping projects depends on national legislation and the local context, but can be quite limited (Aitken et al., 2008) if citizens do not have a veto right. In Germany, for example, community acceptance is not linked to formal approval requirements, and citizens do not have a right of veto, as is the case in Switzerland (Tabi and Wüstenhagen, 2017).

However, even when residents have limited ability to directly influence the outcome of a project through voting, community acceptance is critical to the planning process and ultimately the success of a project. Citizens do have "soft power (…) that can be exerted without enforcement and legitimation" (Schwarz, p. 2, 2020). Citizens may try to influence local incumbents concerning zoning (Jobert et al., 2007) or file lawsuits that delay or stop projects (FA Wind, 2019).

2.2. Distributive justice and financial participation

Distributive justice is part of the wider concept of environmental justice (Gross, 2007). It refers to how fairly perceived costs and profits are shared among project developers and the local community (Walker, 2009; Hall et al., 2013).

Distributive justice suggests that people are willing to accept undesired characteristics, like the impacts of a wind energy project, if they feel their concerns have been heard and recognized, and if perceived costs and profits are shared fairly (Kuehn, 2000; Gross, 2007). If citizens do not share this feeling, local resistance towards developments may grow as the latter perceive that they are only paying the cost of such projects (Walker and Devine-Wright, 2008). The perceived costs of wind farms include noise-related issues (Dällenbach and Wüstenhagen, 2022), visual impacts (Pasqualetti, 2011; Ladenburg, 2014), shadow flickering, navigation lights (Rudolph et al., 2017) and fear about a decline in property value (Jensen et al., 2014), while profits are related to economic benefits like jobs (Warren and McFadyen, 2010) and income from energy sales (McInerney and Curtin, 2017).

One way to increase distributive justice is through financial participation.[3] Financial participation describes how profits from wind projects can be shared between those who build them and those who live close to them (Kuehn, 2000; Gross, 2007). One important question in research is if citizens appreciate financial participation (Musall and Kuik, 2011; Baxter, 2017; Langer et al., 2017; Lienhoop, 2018; van Wijk et al., 2021; Vuichard et al., 2022) and indeed perceive that costs and benefits in projects that use financial participation schemes are shared more fairly (Brennan et al., 2017; Johansen and Emborg, 2018; Leer Jørgensen et al., 2020). And if so, does this perception translate into a higher level of community acceptance of such projects (Hyland and Bertsch, 2018; Vuichard et al., 2019).

Previous research has investigated various elements of the relationship between financial participation and community acceptance. Some studies have analyzed if community ownership or community energy increases acceptance (Breukers and Wolsink, 2007; Warren and McFadyen, 2010; Musall and Kuik, 2011). Community ownership or community energy in the strictest sense means that only citizens who live near a project (e.g., a turbine) can invest and become owners of the infrastructure (e.g., a wind farm). However, as Walker and Devine-Wright (2008) and Baxter et al. (2020) note the term "community energy" is sometimes misapplied to projects that are not solely for the community by community. Instead, such projects could be largely owned by actors outside of it (Curtin et al., 2019; Pons-Seres de Brauwer and Cohen, 2020). The present dissertation refers to the situation when both the project developer and the local community co-invest in a wind farm. This type of investment is located at the intersection of community ownership and developer ownership.

Previous research has also investigated if the type of financial participation is important (Liebe et al., 2017; Hyland and Bertsch, 2018; Vuichard et al., 2019). Financial participation can take different forms. First, it can take the form of the provision of benefits from the developer to the local community or individuals (Bristow et al., 2012; Kerr et al., 2017). This form of financial participation is summarized in the dissertation as profit-sharing without citizens having to make an active contribution in the form of investing their own money (benefit schemes). Discounted electricity tariffs and the sponsorship of sports clubs are two examples of such benefits (García et al., 2016;

[3] Gross (2007) reviews different theories of (environmental) justice and concerns—among others, the terms "distributive justice" and "fairness." The author finds, among other things, that in some literature "the terms justice and fairness can be used interchangeably" Gross (p. 2729, 2007). This dissertation refers to distributive justice as a concept, and fairness as citizens' perception of the reasonable distribution of benefits.

Morris, 2019). Second, financial participation can require citizens to invest in wind farms with their own capital (citizen co-investment). Citizens who invest may be locals and live in close proximity to the wind turbine site (community of locality), but may also come from more geographically distant places (community of interest) (Bristow et al., 2012; Kerr et al., 2017). This dissertation only addresses investment from citizens that live close to wind turbines.

The literature contains quite contradictory results concerning whether financial participation is correlated to the community acceptance of wind energy projects. Some report a high level of acceptance when a community was involved (Warren and McFadyen, 2010; Musall and Kuik, 2011; Mostegl et al., 2017). Others have found that financial participation does not mitigate the perceived costs of wind energy, or that the participation approach is considered inappropriate or immoral, and therefore rejected (Johansen and Emborg, 2018; Leer Jørgensen et al., 2020). Some even report that there may be a sense that the local community is being bribed (Aitken, 2010; Cass et al., 2010). Others have identified the lack of perceived fairness as a reason for the rejection of projects (Gross, 2007).

Further research is required to determine how the topic of financial participation is related to the perceptions of fairness of residents, and ultimately, the community acceptance of wind energy projects.

3. Overview of research papers

Financial participation is becoming increasingly popular among energy stakeholders for increasing community acceptance (Rønne and Gerhardt Nielsen, 2019; The Scottish Government, 2019; Department for Business, 2021). This popularity is based on empirical evidence that such measures can increase acceptance (Warren and McFadyen, 2010; Musall and Kuik, 2011; Mostegl et al., 2017; Vuichard et al., 2022). However, there are also cases when financial benefits have had the opposite effect (Cass et al., 2010; Leer Jørgensen et al., 2020).

The objective of this dissertation is to investigate the relationship between financial participation and community acceptance and to explore explanations for the seemingly contradictory empirical results in the literature. The objective of this dissertation is achieved through three research papers.

Paper 1 concerns local citizens in Germany, and the provision of benefits to them from project developers. Previous studies have mainly been limited to addressing how

financial participation and community acceptance are related. Paper 1 contributes to the literature by examining for whom financial participation increases community acceptance and for whom it does the opposite. Furthermore, it investigates if the effect is different among three different benefit schemes.

The paper uses empirical findings and theories to hypothesize, first, that financial benefits could crowd-out proponents of projects, which was found in nature conservation (Ezzine-de-Blas et al., 2019) and conservation policy (Rode et al., 2015). Second, opponents might not be willing to trade costs and benefits (Walter, 2014; Brennan and Van Rensburg, 2016). If confirmed, both assumptions would mean that only citizens with weak preferences appreciate financial participation and that financial participation has only a weak, zero, or the opposite effect for the other two groups. The paper examines three different models of financial participation: discounted electricity tariff, payments to municipalities, and payments for social purposes.

The first paper finds that most of the sample (94%) – both proponents of wind energy and citizens with weak preferences – prefer financial benefits to foregoing them. A discounted electricity tariff is ranked first, followed by payments to the municipality and payments for social purposes. The paper does not show that financial participation crowds out wind energy proponents, as initially hypothesized. However, it finds for opponents and citizens with weak preferences that benefits may be insufficient for offsetting the perceived costs of wind energy.

Paper 2 focuses on the experience of German wind energy project developers who offer local citizens to invest in their projects. The study explores why, when, and how they use citizen investment between the start of planning and the commissioning of wind farms through semi-structured interviews. Previous studies have focused primarily on the perspective of citizens when researching the relationship between financial participation and community acceptance (Yildiz, 2014; Goedkoop and Devine-Wright, 2016; Lienhoop, 2018; Vuichard et al., 2019; Leiren et al., 2020; Vuichard et al., 2022). Studies that employ project developers as the sample population are less common.

The reason for focusing on project developers is that they have many years of experience of what works in practice and what does not in terms of using financial participation to increase community acceptance. Most of the project developers who were interviewed have experience with projects in different regions of Germany of varying project sizes and context-specific local conditions. The paper supplements

studies that focus on the perceptions of citizens, which for methodological reasons are often limited to either comparing a small number of real projects through case studies (Warren and McFadyen, 2010; Musall and Kuik, 2011; Mostegl et al., 2017) or are limited to experimental settings that use a large sample and hypothetical projects (Bertsch et al., 2017; Vuichard et al., 2019; Tanujaya et al., 2020; Vuichard et al., 2022). The experience of many implemented and failed projects through interviews with project developers supplements prior literature.

Project developers stated in the interviews that they offer financial participation to increase community acceptance. Regardless of their background, they indicated that offering citizens an opportunity to invest in a project was costly and that they could finance their projects more cheaply with other options. Clearly, financing projects was a welcome side effect but not the primary motivation for offering citizen co-investment, as the project developers repeatedly clarified.

The paper also found that project developers primarily use two different co-investment models: Equity investment, which gives citizens voting control, and debt investment. The former is mainly offered in early project phases, while the latter is usually offered during the time of commissioning. The use of equity investment is not always suitable, according to the project developers. Such a form of investment may be too risky for citizens to consider acceptable. Furthermore, equity investment contradicts the goal of some project developers of exiting projects with a clean capital structure.

The developers explained that debt investment solves the problem of equity investment – first, by lessening the investment risk for citizens because the project is already advanced when debt investment is offered, and second, because debt investment does not involve voting control, thus does not add complexity to exiting.

However, developers also stated some disadvantages of debt investment. Offering debt investment at later stages of a project as an alternative to equity investment means that project developers cannot offer the community an investment opportunity at early stages of the project when community acceptance is critical to the success of projects. Because the project developers want to increase community acceptance at early project phases, they announce that citizens will have the opportunity to invest at later project phases. Project developers hope this early prospect will increase local support long before they can make a concrete offer.

Paper 3 reviews empirical research papers that consider citizen investment and community acceptance in relation to onshore wind energy. The paper contributes to

the literature by conceptualizing citizen investments and exploring factors systematically across empirical studies that explain why there is sometimes a positive relationship and sometimes the opposite between citizen investment and community acceptance.

The paper acknowledges that the focus on citizen investment overlaps with the literature on citizen energy. However, citizen investment goes further than the latter. Citizen investment as a form of community investment is located at the intersection between community energy and fully developer-owned projects. This intersection is not fully covered by the literature yet.

The paper is a relevant contribution to the social acceptance literature because citizen investment is becoming more popular because of policies like the European Union's Recast Energy Directive / 2018/2001/EU RED II (European Parliament and Council of Europe, 2018, 2019), which promotes active energy citizens and communities for the purpose of increasing community acceptance and inclusion in renewable energy development. The offer of citizen investment is expected to increase, as is the demand for empirical evidence to support policy and practice.

Paper 3 finds that different citizen investment models are considered by literature. First, it identifies the terminology applied to citizen investment into wind farms. Second, it analyses how citizen investment into wind farms is translated into eligibility criteria. Third, it searches for common lessons as to the perceived local acceptability of a citizen investment scheme.

The paper interrogate how issues of perceived fairness, locality and citizen control are influenced by financial factors such as the investment's structure and associated risks, costs and benefits. Apparently, perceived fairness, trust, and risk influence which type of citizen investment model is preferred. Contextual factors like support from key stakeholders is relevant, too. Overall, the paper concludes that citizen investment can increase acceptance. But it may not unleash its full potential hat without considering the above factors. The paper suggests avenues for further research, particularly concerning methodology, theories and concepts.

Table 1: Overview of the three dissertation papers.

No.	Title	Authors	Objective	Method	Publication status
1	**Can't buy me acceptance?** Financial benefits for wind energy projects in Germany	Jakob Knauf[a]	Compare how three different financial participation models relate to community acceptance and explore the factors behind the divergent effects of financial participation and community acceptance	Online survey, Conjoint analysis (Choice-based conjoint)	Published in *Energy Policy*
2	**Crowdsourcing social acceptance:** Why, when and how project developers offer citizens to co-invest in wind power	Jakob Knauf[a], Rolf Wüstenhagen[a]	Explore why, when, and how project developers use citizen investment between the start of planning and the commissioning of the wind farm.	Semi-structured interviews	Published in *Energy Policy*
3	**A matter of acceptability?** Understanding citizen investment schemes in the context of onshore wind farm development	Jakob Knauf[a], Julia le Maitre[b]	Consider the definitions and meanings of citizen investment into onshore wind farms and identify how citizen investment relates to the acceptance wind energy projects by the nearby community. Identify opportunities for further research.	Literature review	Accepted for publication in Renewable and Sustainable Energy Reviews

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4. Methodology

All three dissertation papers use different methodological approaches to examine the relationship between financial participation and community acceptance. The methods used are described below.

The first paper is based on an online survey which included a choice experiment. Using the choice experiment, I investigated the preferences of different project attributes among which financial benefits was the most important one for the purpose of the study. The following financial benefits are considered: discounted electricity tariff, payments to municipalities, and payments for social purposes.

The three different financial benefit schemes were compared to projects that did not offer financial participation (option "no benefits"). The three benefit schemes and the no benefit option were compared and the differences in preferences between them were used to proxy the increase or decrease in community acceptance.

The financial benefit schemes were selected on the basis of current regulatory developments in Europe, especially in Germany (Morris, 2019). In Germany, various benefits were discussed in relation to updating EEG 2021, of which only the voluntary payment to municipalities was included in the law.

Choice experiments are used in the development of new products (Tabi et al., 2014; Hille et al., 2019; Petrovich et al., 2019) and for the analysis of different policy alternatives (Lüthi and Wüstenhagen, 2012; Rinscheid and Wustenhagen, 2019; Côté et al., 2022). They belong to the stated preference methods (Auspurg and Hinz, 2015; Whittington et al., 2017) and enable the eliciting of preferences among respondents, such as citizens, for alternatives which do not (yet) exist (Sawtooth Software, 2017). Choice experiments require respondents to decide between different alternatives. Each alternative consists of a set of attributes in which attribute levels are randomly varied. Several rounds of repetition permit the calculation of preferences for attributes and attribute levels.

The choice experiment in the first paper aims at deriving preferences for a hypothetical local wind energy project. It displayed alternative projects, of which study participants selected their preferred ones. One attribute was financial benefit, with the levels discounted electricity tariff, payments to municipality, payments for social purposes, and no financial participation. The choice experiment was part of an online survey among German citizens. The survey contained standard questions about respondents'

acceptance of wind energy, emotions and attitudes towards wind energy, financial benefits, and psychographic and demographic information.

The sample consisted of 811 German citizens. The entire sample is representative of the German population according to age, gender, and region. For the analysis, the study participants were divided into three groups: proponents, opponents, and citizens with weak preferences. The classification was based on an item-based variable which measured the attitude of the study participants regarding wind energy. The overarching analysis focused on whether financial benefits lead to greater community acceptance of local projects, and specifically whether this is equally true for opponents, proponents, and citizens with weak preferences. Further questions elaborated how citizens perceive the fairness of projects with and without financial benefit schemes. Statistical analysis like Mann-Whitney-U-Tests were used to justify the interpretations of the results and policy recommendations.

The second paper is based on fourteen semi-structured interviews with German wind energy project developers who have at least two years of experience in designing financial participation models for wind energy projects. We selected semi-structured interviews to explore issues that project developers find generally relevant (Kvale, 2007). Using bottom-up thematic analysis (Braun and Clarke, 2006), the paper identifies topics from the interviews that were considered important by the project developers. These are reported and translated into testable propositions for further research.

The interviewees have different backgrounds and represent the types of companies that implement projects most frequently in Germany: project developers and municipal utilities. We studied developers and utilities of various sizes, from sole proprietors to international corporations. Some companies operate only locally, others across Germany, Europe, or even worldwide. For readability, the dissertation refers to project developers, but also includes municipal utilities.

Interviews were conducted between May and July 2021 by phone or videoconference and were recorded, fully transcribed, and analyzed. All respondents voluntarily consented to the recording under conditions of confidentiality.

An interview guide was used to help collect details about the personal and professional background of the project developers, their views about wind energy, and procedural and financial involvement. The focus was on citizen co-investment. Based on the insights from the initial interviews and in light of the experience level of respondents, it turned out to be an effective strategy to let interviewees talk relatively

freely about their projects, and only revert to the survey instrument if important aspects were left untouched. The transcribed interviews were analyzed according to the bottom-up thematic analysis approach described by Braun and Clarke (2006).

Paper 3 reviews papers that addresses citizen investment and community acceptance. It investigates factors that could explain why citizen investment sometimes leads to greater community acceptance and sometimes to the opposite, using in-depth qualitative analysis and categorization. Directions for future research are provided that can serve as a starting point.

In this review, relevant empirical papers that were available before June 2022 were identified from the Web of Science and Scopus, using Google Scholar as a complementary search engine. The search terms relate to (1) wind, (2) investment, (3) community, and (4) acceptance. The search included additional terms that relate to the keywords (e.g., invest, investor) and used alternative spellings for robustness. The search identified 142 unique search results, of which seven papers met the selection criteria. Additional five publications were identified through citation search and one with Google Scholar, resulting in the final sample of 13. To have a coherent sample we only considered advanced economies with established energy systems and used the Energy Transition Index 2020 as a proxy for our analysis (World Economic Forum, 2020)

Two independent researchers were involved in selecting, analyzing, and cross-referencing the results of the collected papers. Based on this, a qualitative analysis of the papers was conducted (Petticrew and Roberts, 2006).

The third paper first explores how citizen investment is interpreted and discussed with focus on the representation of eligibility considerations. It builds on existing research that identifies common themes of projects owned by people living within a specific geographic area (Baxter et al., 2020; Lowitzsch et al., 2020). Each of these papers gives focus to common issues, here referred as eligibility criteria, which are (i) actor representation and the heterogeneity of investors; (ii) the proximity criteria describing how far an investor lives from a development; (iii) the distribution of ownership rights governing the asset and (iv) the legal framework and formal voting structures which determine who is eligible to engage in, or vote on, renewable energy developments. Paper 3 explores in-depth how citizen investment into wind farms is translated into eligibility criteria and common lessons as to the perceived local acceptability of a citizen investment scheme.

5. Overall findings and conclusion

The three papers of this dissertation generate empirical and conceptual insights concerning how financial participation and community acceptance of wind energy are related. I discuss in detail in the following section the theoretical and practical contributions which are relevant for researchers, project developers, and policymakers. Furthermore, I state the overall limitations of the work and offer suggestions for further research.

5.1. Theoretical contributions

The three papers contribute to the research stream on financial participation and the social acceptance of wind energy. First, I was able to show in the first paper that financial benefits can increase community acceptance, but not to the same degree for everyone. Proponents of wind energy and citizens with weak preferences value financial benefits. Opponents of wind energy show no significant preference for the three financial benefits studied. However, citizens do not necessarily associate financial benefits with perception of distributive fairness. In the specific case, I found for wind energy opponents and citizens with weak preferences a statistically significant effect that benefits are not sufficient to balance the perceived costs and gains of wind energy and thus ensure a perception of distributive fairness. Interestingly, proponents and citizens with weak preferences for wind energy neither affirmed nor disaffirmed that costs and benefits are fairly distributed without benefits. To conclude, the results of the paper show that the relationship between financial benefits and perceptions of distributive fairness is not straightforward, as also found by (Leer Jørgensen et al., 2020), and that some citizens are apparently not willing to make trade-offs (Walter, 2014; Brennan and Van Rensburg, 2016).

Second, the first paper contributes to understanding whether there is a difference concerning the preferences of citizens for financial benefit schemes. The paper shows that the discounted electricity tariff ranks first, followed by payments to the municipality, and then payments for social purposes. This finding helps identify whether citizens prefer individual benefits or collective ones (Vuichard et al., 2019).

Third, the second paper and third paper contribute to the understanding of how citizens perceive options to invest in wind power and which factors may drive their preferences. The second paper explores through semi-structured interviews why, when, and how German project developers offer citizens an opportunity to invest in

wind power between the start of planning and the commissioning of a wind farm. The project developers state that they mainly use two types of citizen co-investment for the purpose of increasing community acceptance: equity investment, which gives citizens voting control and is predominantly offered at early project stages, and debt investment, which is usually offered around the time of commissioning. Equity investment is a deeper form of engagement in terms of procedure and distribution (McInerney and Curtin, 2017; Wind Europe, 2021). However, project developers in the interviews state that equity investment is also much riskier for citizen investors and therefore does not fit with the preferences of the average retail investor. This finding is in line with the conclusions of the third paper, which finds that some citizens prefer participation models associated with lesser risk. The experience of project developers and the finding from the literature review have some theoretical implications. Investments like equity grant formal control to citizens. However, this type of deeper involvement only resonates with citizens in some cases, even though they have more opportunities to influence the wind farm planning process, which in theory increases procedural justice. One factor that could explain this is the perceived risk of investments, which is likely to change in different contexts. Clearly, there are some links between the type of citizen co-investment and community acceptance that need further elaboration. Paper three suggests how citizen investment, community acceptance, and risk perception may be related and suggests avenues for further research.

5.2. Practical contributions

The three papers contain findings of practical value for policymakers and wind project developers who are interested in the relationship between financial participation and community acceptance in the development of government policies or project design. My research addresses different financial participation models and explains how they are related to community acceptance. One of the most important implications of this dissertation for policy and practice is that financial participation in most instances is positively associated with community acceptance, as found in the research described in papers 1 and 3. Furthermore, increasing community acceptance is one of the main motives of project developers for offering citizen co-investment, as described in paper 2. In the following, the practical contributions are stated in detail.

First, paper 1 shows that all benefit schemes that were studied – discounted electricity, payments to the municipality, and payments for social purposes – are preferred more

by citizens than having no benefits. This is true for proponents and citizens with weak preferences, who represent 94% of the sample in total. Opponents, on the other hand, show no significant preference for financial benefits. The results support current policies that enable the use of financial benefits.

Second, the research shows that there are differences in citizen preferences for financial participation models. For example, the first paper finds that discounted electricity tariffs are typically preferred by wind energy proponents and citizens with weak preferences. However, also payments to the municipality and for social purposes have a positive effect on community acceptance for most residents of the local community. It is therefore better for project developers to offer some benefits instead of none if they aim at increasing community acceptance.

Third, policymakers should enable a wide variety of different benefits so that project developers can choose the model that they prefer for their projects. For Germany, the results mean that in the forthcoming revised version of the renewable energy sources act (EEG) and energy market design, discounted electricity tariffs should also be considered (they are not yet covered by the law).

Fourth, it is a relevant finding for policymakers and project developers that there is a trade-off between offering citizen co-investment at early and later stages. Early-stage co-investment is on the one hand desirable for anchoring a project in a local community early on but is associated with greater risk for citizen investors. The goal of early involvement can backfire if losses occur at some point in the project due to changing (planning) conditions. The second paper shows that policymakers should be aware of this trade-off between broad participation and the risk of financial losses. They should not promote early-stage co-investment through their policies too readily, given the current high level of project risk and the limited uptake of such offerings to only a few risk-taking investors. However, policymakers can create conditions associated with lesser planning risk for wind energy projects, like the current spring and summer program of the German government proposes. It aims to expand land available for wind energy development and simplify planning and permitting processes (BMWK, 2022). Such policies help to reduce the risk of projects and thus early citizen investment, which could facilitate earlier participation.

Fifth, financial participation is not a silver bullet. Project developers and policymakers should not assume that a sense of fair distribution is automatically guaranteed when financial benefits are offered, as paper 1 and 3 show. The exclusive use of financial participation like citizen co-investment without considering the local context can

minimize or even undermine the aim of increasing community acceptance. Instead, offering financial participation, perceived risk and fairness, and building trust should be viewed as interrelated and actions should go hand in hand to target them.

5.3. Overall limitations and suggestions for further research

The dissertation investigates the relationship between financial participation and community acceptance. It contributes to both academia and practice but is subject to specific limitations. The following section lists these and identifies avenues for future research.

First, preferences develop and change over time (Wolsink, 1989; Cousse et al., 2020). Changes occur with wind energy in the context of projects (Wolsink, 2007), but also at a more general societal level as the energy transition moves forward (Ferraro and Ellis, 2017). The first paper is cross-sectional. It investigates preferences concerning wind projects and financial participation only at one point in time – when citizens are informed about the possibility to benefit from a wind park close to their homes. Preferences concerning financial participation could change as projects move forward, and how they change would be an interesting topic for future research.

Second, two of the three papers in the dissertation focus on Germany. Therefore, the results apply primarily to this country. It would be interesting to see if and how the results differ in other countries. For example, Germany has a long history of citizen energy and policies that have driven the development of wind energy by providing guarantees like fixed feed-in tariffs. In this respect, the context is similar to in some other countries such as Denmark (Munday et al., 2011). Other countries, such as Ireland, Spain, and parts of the UK, have traditionally tended to be undertaken by developers and therefore the context is different in terms of citizen participation (Toke et al., 2008; Munday et al., 2011). Against this background it would be interesting to survey citizens and interview project developers in such countries regarding their experience with financial participation, risk perceptions and preferences concerning the form of participation, also considering that countries have different legal frameworks that influence the choice of models (Bolinger, 2001; Ferraro and Ellis, 2017; Hoicka et al., 2021).

The third limitation and opportunity for further research concerns the link between perceptions of distributive fairness, community acceptance, and financial participation. The first paper shows that citizens' perceptions of fair distribution are not automatically associated with financial benefits. This finding is complemented by

Leer Jørgensen et al. (2020) who show that investment in a project does not automatically mean that the project is accepted. How perceptions of distributive fairness evolve and how they are related to trust, risk perception, and time requires further empirical research (see third paper).

Fourth, project developers stated in the interviews for the second paper that they face a dilemma between offering early but risky participation, and later but low-risk participation. They resolve this by announcing early in the planning process a low-risk participation opportunity that they will offer later to citizens, around the time of the commissioning of the wind farm. In this way, risk is minimized for citizen investors because they can invest in (almost) running projects, but residents know early in the planning process that they will be involved – which may increase community acceptance at that stage. It would be interesting to study how the approach of early announcement and later involvement affects community acceptance by conducting a study among residents. Until now there is some evidence in the literature that early announcement and later participation can have the opposite effect if trust is lacking (Goedkoop and Devine-Wright, 2016; Brennan et al., 2017; Leer Jørgensen et al., 2020).

Fifth, another area for further research concerns the reasons why some citizens prefer participation associated with a high level of engagement, and others prefer models with less. The second and third paper identifies the fact that risk perceptions might be important. Citizens have different risk perceptions and their preferences concerning financial participation are probably different (Hyland and Bertsch, 2018; Vuichard et al., 2019). However, paper 3 shows that other factors like time and key stakeholders might play a role in the development of preferences and changes in risk perceptions. It would be interesting to explore further the role of risk perceptions and what factors affect whether financial participation is perceived as more or less risky.

References

Aitken, M., 2010. Wind power and community benefits: Challenges and opportunities. Energy Policy 38, 6066-6075.

Aitken, M., McDonald, S., Strachan, P., 2008. Locating 'power' in wind power planning processes: the (not so) influential role of local objectors. Journal of Environmental Planning and Management 51, 777-799.

Auspurg, K., Hinz, T., 2015. Multifactorial Experiments in Surveys, in: Keuschnigg, M., Wolbring, T. (Eds.), Experimente in den Sozialwissenschaften. Nomos, Baden-Baden, pp. 294-320.

Avila, S., 2018. Environmental justice and the expanding geography of wind power conflicts. Sustainability Science 13, 599-616.

Barrera-Hernández, L.K., Barton, B., Godden, L., Lucas, A.R., Rønne, A., 2016. Sharing the costs and benefits of energy and resource activity: legal change and impact on communities, First edition ed. Oxford University Press, Oxford.

Batel, S., 2017. A critical discussion of research on the social acceptance of renewable energy generation and associated infrastructures and an agenda for the future. Journal of Environmental Policy & Planning 20, 356-369.

Baxter, J., 2017. Energy justice: Participation promotes acceptance. Nature Energy 2.

Baxter, J., Walker, C., Ellis, G., Devine-Wright, P., Adams, M., Fullerton, R.S., 2020. Scale, history and justice in community wind energy: An empirical review. Energy Res. Soc. Sci. 68.

Beery, J.A., Day, J.E., 2015. Community investment in wind farms: funding structure effects in wind energy infrastructure development. Environ Sci Technol 49, 2648-2655.

Bell, D., Gray, T., Haggett, C., 2005. The 'Social Gap' in Wind Farm Siting Decisions: Explanations and Policy Responses. Environmental Politics 14, 460-477.

Bertsch, V., Hyland, M., Mahony, M., 2017. What drives people's opinions of electricity infrastructure? Empirical evidence from Ireland. Energy Policy 106, 472-497.

Blanchet, T., 2015. Struggle over energy transition in Berlin: How do grassroots initiatives affect local energy policy-making? Energy Policy 78, 246-254.

BMU, 2021. Klimaschutz in Zahlen.

BMWi, 2020. Nationalen Energie- und Klimaplans (NECP) Federal Ministry for Economic Affairs and Energy (BMWi), Berlin.

BMWK, 2022. Uberblickspapier: Beschleunigung des Ausbaus erneuerbarer Energien und Erweiterung der Vorsorgemaßnahmen.

Bolinger, M., 2001. Community wind power ownership schemes in Europe and their relevance to the United States. Lawrence Berkeley National Laboratory.

Braun, V., Clarke, V., 2006. Using thematic analysis in psychology. Qualitative Research in Psychology 3, 77-101.

Brennan, N., Van Rensburg, T.M., 2016. Wind farm externalities and public preferences for community consultation in Ireland: A discrete choice experiments approach. Energy Policy 94, 355-365.

Brennan, N., Van Rensburg, T.M., Morris, C., 2017. Public acceptance of large-scale wind energy generation for export from Ireland to the UK: evidence from Ireland. Journal of Environmental Planning and Management 60, 1967-1992.

Breukers, S., Wolsink, M., 2007. Wind power implementation in changing institutional landscapes: An international comparison. Energy Policy 35, 2737-2750.

Bristow, G., Cowell, R., Munday, M., 2012. Windfalls for whom? The evolving notion of 'community' in community benefit provisions from wind farms. Geoforum 43, 1108-1120.

Burningham, K., Barnett, J., Walker, G., 2015. An Array of Deficits: Unpacking NIMBY Discourses in Wind Energy Developers' Conceptualizations of Their Local Opponents. Society & Natural Resources 28, 246-260.

Cass, N., Walker, G., Devine-Wright, P., 2010. Good Neighbours, Public Relations and Bribes: The Politics and Perceptions of Community Benefit Provision in Renewable

Energy Development in the UK. Journal of Environmental Policy & Planning 12, 255-275.

Côté, E., Đukan, M., Pons-Seres de Brauwer, C., Wüstenhagen, R., 2022. The price of actor diversity: Measuring project developers' willingness to accept risks in renewable energy auctions. Energy Policy 163.

Cousse, J., Wüstenhagen, R., Schneider, N., 2020. Mixed feelings on wind energy: Affective imagery and local concern driving social acceptance in Switzerland. Energy Res. Soc. Sci. 70.

Curtin, J., McInerney, C., Gallachóir, B.Ó., Salm, S., 2019. Energizing local communities—What motivates Irish citizens to invest in distributed renewables? Energy Res. Soc. Sci. 48, 177-188.

Dällenbach, N., Wüstenhagen, R., 2022. How far do noise concerns travel? Exploring how familiarity and justice shape noise expectations and social acceptance of planned wind energy projects. Energy Res. Soc. Sci. 87.

Department for Business, E.I.S., 2021. Community Engagement and Benefits from Onshore Wind Developments. Good Practice Guidance for England.

Deutsche WindGuard, 2021. Status des Windenergieausbaus an Land in Deutschland.

Devine-Wright, P., Sherry-Brennan, F., 2019. Where do you draw the line? Legitimacy and fairness in constructing community benefit fund boundaries for energy infrastructure projects. Energy Res. Soc. Sci. 54, 166-175.

Devine-Wright, P., Wiersma, B., 2020. Understanding community acceptance of a potential offshore wind energy project in different locations: An island-based analysis of 'place-technology fit'. Energy Policy 137.

Dimitropoulos, A., Kontoleon, A., 2009. Assessing the determinants of local acceptability of wind-farm investment: A choice experiment in the Greek Aegean Islands. Energy Policy 37, 1842-1854.

Evans, B., Parks, J., Theobald, K., 2011. Urban wind power and the private sector: community benefits, social acceptance and public engagement. Journal of Environmental Planning and Management 54, 227-244.

Ezzine-de-Blas, D., Corbera, E., Lapeyre, R., 2019. Payments for Environmental Services and Motivation Crowding: Towards a Conceptual Framework. Ecological Economics 156, 434-443.

FA Wind, 2019. Hemmnisse beim Ausbau der Windenergie in Deutschland – Ergebnisse einer Branchenumfrage, Berlin.

FA Wind, 2022. Hemmnisse beim Ausbau der Windenergie an Land - Ergebnisse einer Branchenbefragung.

Falkner, R., 2016. The Paris Agreement and the new logic of international climate politics. International Affairs 92, 1107-1125.

Ferraro, G., Ellis, G., 2017. The social acceptance of wind energy.

García, J.H., Cherry, T.L., Kallbekken, S., Torvanger, A., 2016. Willingness to accept local wind energy development: Does the compensation mechanism matter? Energy Policy 99, 165-173.

Goedkoop, F., Devine-Wright, P., 2016. Partnership or placation? The role of trust and justice in the shared ownership of renewable energy projects. Energy Res. Soc. Sci. 17, 135-146.

Gross, C., 2007. Community perspectives of wind energy in Australia: The application of a justice and community fairness framework to increase social acceptance. Energy Policy 35, 2727-2736.

Haggett, C., Aitken, M., Rudolph, D., van Veelen, B., Harnmeijer, J., Markantoni, M., 2014. Supporting Community Investment in Commercial Renewable Energy Schemes.

Hall, N., Ashworth, P., Devine-Wright, P., 2013. Societal acceptance of wind farms: Analysis of four common themes across Australian case studies. Energy Policy 58, 200-208.

Hallan, C., González, A., 2020. Adaptive responses to landscape changes from onshore wind energy development in the Republic of Ireland. Land Use Policy 97.

Hille, S., Weber, S., Brosch, T., 2019. Consumers' preferences for electricity-saving programs: Evidence from a choice-based conjoint study. Journal of Cleaner Production 220, 800-815.

Hoicka, C.E., Lowitzsch, J., Brisbois, M.C., Kumar, A., Ramirez Camargo, L., 2021. Implementing a just renewable energy transition: Policy advice for transposing the new European rules for renewable energy communities. Energy Policy 156.

Holstenkamp, L., 2014. Local investment schemes for renewable energy: A financial perspective, Renewable Energy Law in the EU, pp. 232-255.

Horbaty, R., Huber, S., Ellis, G., 2012. Large-scale wind deployment, social acceptance. Wiley Interdisciplinary Reviews-Energy and Environment 1, 194-205.

Hyland, M., Bertsch, V., 2018. The Role of Community Involvement Mechanisms in Reducing Resistance to Energy Infrastructure Development. Ecological Economics 146, 447-474.

Intergovernmental Panel on Climate Change, 2022. Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, in: H.-O. Pörtner, D.C.R., M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (Ed.).

International Renewable Energy Agency, International Energy Agency, REN21, 2018. Renewable Energy Policies in a Time of Transition.

Ioannidis, R., Koutsoyiannis, D., 2020. A review of land use, visibility and public perception of renewable energy in the context of landscape impact. Applied Energy 276.

Jensen, C.U., Panduro, T.E., Lundhede, T.H., 2014. The Vindication of Don Quixote: The Impact of Noise and Visual Pollution from Wind Turbines. Land Economics 90, 668-682.

Jobert, A., Laborgne, P., Mimler, S., 2007. Local acceptance of wind energy: Factors of success identified in French and German case studies. Energy Policy 35, 2751-2760.

Johansen, K., Emborg, J., 2018. Wind farm acceptance for sale? Evidence from the Danish wind farm co-ownership scheme. Energy Policy 117, 413-422.

Kerr, S., Johnson, K., Weir, S., 2017. Understanding community benefit payments from renewable energy development. Energy Policy 105, 202-211.

Kuehn, R.R., 2000. A Taxonomy of Environmental Justice. Environmental Law Reporter 30, 10681.

Kvale, S., 2007. Doing interviews, 1. publ. ed. SAGE, Los Angeles [u.a.].

Ladenburg, J., 2014. Dynamic properties of the preferences for renewable energy sources – A wind power experience-based approach. Energy 76, 542-551.

Langer, K., Decker, T., Menrad, K., 2017. Public participation in wind energy projects located in Germany: Which form of participation is the key to acceptance? Renewable Energy 112, 63-73.

Larson, E.C., Krannich, R.S., 2016. "A Great Idea, Just Not Near Me!" Understanding Public Attitudes About Renewable Energy Facilities. Society & Natural Resources 29, 1436-1451.

Leer Jørgensen, M., Anker, H.T., Lassen, J., 2020. Distributive fairness and local acceptance of wind turbines: The role of compensation schemes. Energy Policy 138.

Leiren, M.D., Aakre, S., Linnerud, K., Julsrud, T.E., Di Nucci, M.-R., Krug, M., 2020. Community Acceptance of Wind Energy Developments: Experience from Wind Energy Scarce Regions in Europe. Sustainability 12.

Liebe, U., Bartczak, A., Meyerhoff, J., 2017. A turbine is not only a turbine: The role of social context and fairness characteristics for the local acceptance of wind power. Energy Policy 107, 300-308.

Lienhoop, N., 2018. Acceptance of wind energy and the role of financial and procedural participation: An investigation with focus groups and choice experiments. Energy Policy 118, 97-105.

Lowitzsch, J., Hoicka, C.E., van Tulder, F.J., 2020. Renewable energy communities under the 2019 European Clean Energy Package – Governance model for the energy clusters of the future? Renewable and Sustainable Energy Reviews 122.

Lüthi, S., Wüstenhagen, R., 2012. The price of policy risk — Empirical insights from choice experiments with European photovoltaic project developers. Energy Economics 34, 1001-1011.

McInerney, C., Curtin, J., 2017. Financial incentives to promote citizen investment in low-carbon and resource-efficient assets.

Miller, C.A., Iles, A., Jones, C.F., 2013. The Social Dimensions of Energy Transitions. Science as Culture 22, 135-148.

Mjahed Hammami, S., Chtourou, S., Al Moosa, H., 2018. A holistic approach to understanding the acceptance of a community-based renewable energy project: A pathway to sustainability for Tunisia's rural region. Business Strategy and the Environment 27, 1535-1545.

Morris, C., 2019. Community energy in Germany. Agentur für Erneuerbare Energien.

Mostegl, N.M., Pröbstl-Haider, U., Haider, W., 2017. Spatial energy planning in Germany: Between high ambitions and communal hesitations. Landscape and Urban Planning 167, 451-462.

Munday, M., Bristow, G., Cowell, R., 2011. Wind farms in rural areas: How far do community benefits from wind farms represent a local economic development opportunity? Journal of Rural Studies 27, 1-12.

Musall, F.D., Kuik, O., 2011. Local acceptance of renewable energy—A case study from southeast Germany. Energy Policy 39, 3252-3260.

Olsen, B.E., 2010. Wind Energy and Local Acceptance: How to Get Beyond the Nimby Effect. European Energy and Environmental Law Review, 239-251.

Pasqualetti, M.J., 2011. Opposing Wind Energy Landscapes: A Search for Common Cause. Annals of the Association of American Geographers 101, 907-917.

Petrovich, B., Hille, S.L., Wüstenhagen, R., 2019. Beauty and the budget: A segmentation of residential solar adopters. Ecological Economics 164.

Petticrew, M., Roberts, H., 2006. Systematic Reviews in the Social Sciences.

Pons-Seres de Brauwer, C., Cohen, J.J., 2020. Analysing the potential of citizen-financed community renewable energy to drive Europe's low-carbon energy transition. Renewable and Sustainable Energy Reviews 133.

Rand, J., Hoen, B., 2017. Thirty years of North American wind energy acceptance research: What have we learned? Energy Res. Soc. Sci. 29, 135-148.

Rinscheid, A., Wustenhagen, R., 2019. Germany's decision to phase out coal by 2038 lags behind citizens' timing preferences. Nat Energy 4, 856-863.

Rode, J., Gómez-Baggethun, E., Krause, T., 2015. Motivation crowding by economic incentives in conservation policy: A review of the empirical evidence. Ecological Economics 117, 270-282.

Rogers, E.M., 1995. Diffusion of innovations. Free Press, New York.

Rønne, A., Gerhardt Nielsen, F., 2019. Consumer (Co-)Ownership in Renewables in Denmark, Energy Transition, pp. 223-244.

Rudolph, D., Kirkegaard, J., Lyhne, I., Clausen, N.-E., Kørnøv, L., 2017. Spoiled darkness? Sense of place and annoyance over obstruction lights from the world's largest wind turbine test centre in Denmark. Energy Res. Soc. Sci. 25, 80-90.

Sawtooth Software, 2017. The CBC System for Choice-Based Conjoint Analysis, in: Sawtooth Software, I. (Ed.), Technical paper series, 9 ed, Orem, Utah.

Schwarz, L., 2020. Empowered but powerless? Reassessing the citizens' power dynamics of the German energy transition. Energy Res. Soc. Sci. 63.

Shared Ownership Task Force, 2014. Report to DECC.

Sovacool, B.K., Lakshmi Ratan, P., 2012. Conceptualizing the acceptance of wind and solar electricity. Renewable and Sustainable Energy Reviews 16, 5268-5279.

Stauch, A., Gamma, K., 2020. Cash vs. solar power: An experimental investigation of the remuneration-related design of community solar offerings. Energy Policy 138.

Stern, P.C., 2017. How can social science research become more influential in energy transitions? Energy Res. Soc. Sci. 26, 91-95.

Tabi, A., Hille, S.L., Wüstenhagen, R., 2014. What makes people seal the green power deal? — Customer segmentation based on choice experiment in Germany. Ecological Economics 107, 206-215.

Tabi, A., Wüstenhagen, R., 2017. Keep it local and fish-friendly: Social acceptance of hydropower projects in Switzerland. Renewable and Sustainable Energy Reviews 68, 763-773.

Tanujaya, R.R., Lee, C.-Y., Woo, J., Huh, S.-Y., Lee, M.-K., 2020. Quantifying Public Preferences for Community-Based Renewable Energy Projects in South Korea. Energies 13.

The Scottish Government, 2019. Scottish Government Good Practice Principles for Shared Ownership of Onshore Renewable Energy Developments.

Toke, D., Breukers, S., Wolsink, M., 2008. Wind power deployment outcomes: How can we account for the differences? Renewable and Sustainable Energy Reviews 12, 1129-1147.

van Wijk, J., Fischhendler, I., Rosen, G., Herman, L., 2021. Penny wise or pound foolish? Compensation schemes and the attainment of community acceptance in renewable energy. Energy Res. Soc. Sci. 81.

Vuichard, P., Broughel, A., Wüstenhagen, R., Tabi, A., Knauf, J., 2022. Keep it local and bird-friendly: Exploring the social acceptance of wind energy in Switzerland, Estonia, and Ukraine. Energy Res. Soc. Sci. 88.

Vuichard, P., Stauch, A., Dällenbach, N., 2019. Individual or collective? Community investment, local taxes, and the social acceptance of wind energy in Switzerland. Energy Res. Soc. Sci. 58.

Walker, B.J.A., Russel, D., Kurz, T., 2016. Community Benefits or Community Bribes? An Experimental Analysis of Strategies for Managing Community Perceptions of

Bribery Surrounding the Siting of Renewable Energy Projects. Environment and Behavior 49, 59-83.

Walker, B.J.A., Wiersma, B., Bailey, E., 2014. Community benefits, framing and the social acceptance of offshore wind farms: An experimental study in England. Energy Res. Soc. Sci. 3, 46-54.

Walker, G., 2009. Beyond Distribution and Proximity: Exploring the Multiple Spatialities of Environmental Justice. Antipode 41, 614-636.

Walker, G., Devine-Wright, P., 2008. Community renewable energy: What should it mean? Energy Policy 36, 497-500.

Walter, G., 2014. Determining the local acceptance of wind energy projects in Switzerland: The importance of general attitudes and project characteristics. Energy Res. Soc. Sci. 4, 78-88.

Warren, C.R., McFadyen, M., 2010. Does community ownership affect public attitudes to wind energy? A case study from south-west Scotland. Land Use Policy 27, 204-213.

Whittington, D., Adamowicz, W., Lloyd-Smith, P., 2017. Asking Willingness-to-Accept Questions in Stated Preference Surveys: A Review and Research Agenda. Annual Review of Resource Economics 9, 317-336.

Wilson, C., Grubler, A., 2013. Energy Technology Innovation, in: Grubler, A., Wilson, C. (Eds.), Energy Technology Innovation: Learning from Historical Successes and Failures. Cambridge University Press, Cambridge, pp. 3-10.

Wilson, C., Grubler, A., Gallagher, K.S., Nemet, G.F., 2012. Marginalization of end-use technologies in energy innovation for climate protection. Nature Climate Change 2, 780-788.

Wind Europe, 2021. Financing and investment trends. The European wind industry in 2020, in: Rory O'Sullivan (Ed.).

Wolsink, M., 1989. Attitudes and expectancies about wind turbines and wind farms. Wind Engineering 13, 196-206.

Wolsink, M., 2000. Wind power and the NIMBY-myth: institutional capacity and the limited significance of public support. Renewable Energy 21, 49-64.

Wolsink, M., 2007. Wind power implementation: The nature of public attitudes: Equity and fairness instead of 'backyard motives'. Renewable and Sustainable Energy Reviews 11, 1188-1207.

Wolsink, M., 2018. Social acceptance revisited: gaps, questionable trends, and an auspicious perspective. Energy Res. Soc. Sci. 46, 287-295.

World Economic Forum, 2020. Fostering Effective Energy Transition, Cologny/Geneva ,Switzerland.

Wüstenhagen, R., Wolsink, M., Bürer, M.J., 2007. Social acceptance of renewable energy innovation: An introduction to the concept. Energy Policy 35, 2683-2691.

Yildiz, Ö., 2014. Financing renewable energy infrastructures via financial citizen participation – The case of Germany. Renewable Energy 68, 677-685.

Paper I

Can't buy me acceptance?
Financial benefits for wind energy projects in Germany[4]

Jakob Knauf[5][6]

Abstract

Local opposition to wind energy projects in Europe and North America is growing. This often causes project delays or even failure. Financial benefits may be one way to counteract a lack of community support. This analysis seeks to explain how discounted electricity, payments to the municipality, and payments for social purposes shift the acceptance of communities about a local wind energy project. A choice-based conjoint analysis among 811 German citizens showed that financial benefits increase citizens' acceptance of a hypothetical wind energy project in the close vicinity of their homes. Proponents and the large group of citizens with rather weak preferences for local wind energy projects appreciate all tested benefits. In contrast, benefits cannot win over the small group of opponents. The study provides evidence that benefits do not ensure the perception of fair distributive justice, even for citizens with weak preferences. The findings inform current policies that introduce benefit schemes for wind energy projects to foster community acceptance and win over majority support for projects.

Keywords: wind energy, financial benefits, distributive justice, community acceptance, choice experiment, segmentation

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1. Introduction

Researchers worldwide are presenting pathways that humankind could take to limit global warming. Their analyses are often based on sophisticated climate and energy models. The IPCC (2018) has issued a special report that summarizes findings from various models (AIM, MESSAGE, REMIND, and WEM). The authors come to the conclusion that wind energy is critical when it comes to clean energy production.

Wind energy projects in Europe and North America consistently face local opposition, resulting in delays or even failure (Wolsink, 2000; Evans et al., 2011; Enevoldsen and Sovacool, 2016; Bertsch et al., 2017). Community acceptance is critical for increasing the pace of the energy transition. It refers to the approval of local stakeholders of the siting of renewable energy projects (Wüstenhagen et al., 2007).

Financial benefits have become increasingly popular with energy stakeholders for fostering community acceptance. Such benefits involve direct or indirect payments to local stakeholders. Their popularity is based on empirical evidence that such measures can increase the acceptance of people who live in the vicinity of proposed wind turbine sites (Toke et al., 2008; Hyland and Bertsch, 2018).

However, financial benefits may have the opposite effect (Cass et al., 2010; Leer Jørgensen et al., 2020). Some reported reasons for this are flawed planning processes and perceived unfair distribution (Rand and Hoen, 2017). This study argues that these factors do not explain all empirical observations, especially when some citizens appreciate and others oppose financial benefits related to the same projects.

This study tests whether a reconsideration of distributive justice theory and the segmentation of local communities in terms of wind energy proponents, opponents, and citizens with weak preferences can explain the ambivalent effect of financial participation on communities. Previous research makes reference to this approach (Cass et al., 2010; Leer Jørgensen et al., 2020), but to the best of the present author's knowledge, this study is the first to use a quantitative method to test it.

The present study addresses the following research question: How do benefits affect the community acceptance of proponents, opponents, and citizens with weak preferences in relation to wind energy projects? A choice-based conjoint analysis (CBC) applied to a representative sample of German citizens (N=811) was the basis of the empirical design. The subject of the study was a hypothetical wind energy project planned in close vicinity to respondents' homes. CBC analysis was used to obtain utilities that were treated a measure of acceptance for three specific financial benefit

models: discounts on electricity tariff, payments to the municipality, and payments for social purposes. These benefits are compared to a project that offers no financial benefits. Based on Lancaster's (1966) theory of consumer behavior, the research assumed that respondents would aim at maximizing their utility (for example, the utility associated with a wind park near their homes). An increase in utility due to project characteristics like financial benefits was interpreted as greater acceptance.

The findings of this study are highly relevant to energy stakeholders who hope that financial benefits may increase the acceptance of renewable energy projects. While the study cannot confirm that financial benefits negatively affect acceptance, as some of the literature has found, the results show that benefits do not increase acceptance among all respondents –

opponents value benefits slightly but not statistically significantly more than no benefits. In contrast, citizens with weak preferences and project proponents appreciate benefits. Financial benefits are therefore not a panacea in terms of increasing the acceptance of all citizens, but they could help to win over the large and important group of citizens with weak preferences.

The structure of this study is as follows. Chapter 2 presents the theoretical background, summarizes empirical findings about the effect of financial benefits on the community acceptance of wind energy, and presents hypotheses. 3 describes the methods applied. Results are presented in Chapter 4, while Chapter 5 draws conclusions, makes recommendations for policy makers, and describes the limitations of the study.

2. Literature review and hypotheses development

Financial incentives may influence individual behavior. This section summarizes empirical evidence for the effect of financial benefits on community acceptance in relation to wind energy projects. The hypotheses result from the literature review. This study understands financial participation as a process, and financial benefits as a type of financial participation model by which local stakeholders receive direct or indirect payments from the project developer, with no prior investment in the project.

2.1. The effect of financial benefits on the community acceptance of wind energy

This section presents empirical findings and theoretical explanations about the effect of financial participation on the community acceptance of wind energy. It first presents

findings from quantitative studies that addressed financial participation. Both positive and negative perceptions are central here. Theories, especially distributive justice theory and motivation crowding theory, could explain the ambivalent effect of financial participation that studies – especially qualitative ones – have found. The summary of the literature clarifies the research gap that this study aims to close. The section particularly justifies the differentiation between wind energy proponents, opponents, and citizens with weak preferences in relation to the effect of financial benefits on community acceptance. Table 1 summarizes this section.

Literature has investigated how financial participation influences the community acceptance of wind energy. Many studies have used quantitative methods. Liebe et al. (2017) used a factorial survey experiment to illustrate that ownership (in the form of citizen-owned turbines and consumption of local electricity) positively influences the acceptance of onshore wind energy projects in Germany and Poland. Lienhoop (2018) explored preferences for different financial participation models in wind energy projects in Germany through a choice experiment. The author shows that distribution is important for rural citizens. Compensation payments to the municipality are preferred over co-ownership. Similarly, Hyland and Bertsch (2018) investigated four involvement models for wind farms in Ireland and found a preference for financial compensation over ownership. García et al. (2016) found from a choice experiment among Norwegian citizens that collective benefits are preferred over individual payments. Similarly, Walker et al. (2014) analyzed different framings and found that the 'community benefit frame' is preferred to individual benefits in offshore wind projects. Vuichard et al. (2019) compared how different financial participation models influence community acceptance among Swiss citizens. They found no significant influence of financial participation on community acceptance. However, models which benefit the entire community, in particular through a local resource tax, were favored over bonds. Some results of the study are only significant for some segments of the community, such as community-attached people or citizens with a politically centrist and progressive mindset. The study illustrates how segmentation can help to generate a clearer picture of the effect of financial participation on community acceptance.

There is empirical evidence that some citizens do not value financial participation. Brennan and Van Rensburg (2016) found from a choice-based conjoint analysis that most, but not all respondents are willing to make trade-offs between monetary, physical, and social attributes to accept wind projects – particularly if respondents have a negative attitude towards them. Walter (2014) conducted a survey experiment among 919 Swiss citizens. The author used yearly lease payments to landowners, a

municipal fund, and the opportunity to buy shares as financial participation models. The level of acceptance of participants with a generally moderate or positive attitude depended on the associated local benefits, but these were not pivotal for people with a generally negative attitude. The author assumes that participants with a negative attitude are not open to making trade-offs between benefits and other values.

This effect was further investigated in qualitative studies. Cass et al. (2010) found from interviews among key stakeholders and case studies in the UK that some citizens interpret community benefits as a form of bribery – particularly people who actively oppose such developments, but also those who are not very active in local debates. The authors conclude that citizens have an ambivalent view towards benefits and the reason for their distribution. Identifying the appropriate financial participation model and giving meaning to it remains problematic. Leer Jørgensen et al. (2020) observed the similar attitude that some citizens perceive compensation schemes as inappropriate or immoral because they do not address non-monetary burdens or are not compatible with their values.

The most common theory for explaining the correlation between financial participation and community acceptance is distributive justice theory. In the present context, this refers to how fairly project developers and the local community share perceived costs and profits (Kuehn, 2000; Gross, 2007). The generally positive effect of financial participation and community acceptance supports this theory.

The empirical finding that financial participation may reduce the acceptance of some citizens only contradicts distributive justice theory at first sight. Financial participation is probably not the right means of affecting the preference structure of some citizens, especially opponents, or enabling a fair distribution of costs and profits. For opponents, either the cost of wind energy could be too high, or they may not be willing to make trade-offs. If distribution is important to them, financial participation is probably not an appropriate means of addressing this.

Distributive justice is probably also not an important factor for wind energy proponents. This study assumes that proponents perceive such projects to be fair even without financial participation, and thus are positive about them generally. Benefits therefore should not increase the acceptance of wind energy further. In contrast, they might even have the opposite effect.

Studies in other environmental fields, like nature conservation (Ezzine-de-Blas et al., 2019) and conservation policy (Rode et al., 2015), found ambivalent effects for financial incentives. These meta studies consider that two main mechanisms of motivation-

crowding theory explain this effect. First, people engage in activities simply because they derive satisfaction from them. The driver of this mechanism is called intrinsic motivation. Second, people may act because of incentives, like financial benefits. The driver here is extrinsic motivation (Titmuss, 1970; Deci, 1971; Frey, 1997). Extrinsic motivation can act independently of intrinsic motivation and, if oppositional, may decrease acceptance (Deci, 1976; Frey, 1997). This study assumes that wind energy proponents may derive satisfaction by supporting wind energy, thus financial benefits could diminish this intrinsic support and thus have ambivalent effects on community acceptance.

2.2. Hypothesis development

Previous studies found a general positive correlation between financial benefits and community acceptance. This study assumes that the effect is especially due to the existence of citizens with weak preferences who appreciate financial benefits because of the perceived fairer distribution of costs and profits. The study tests this assumption with the following hypothesis:

H1. Citizens with weak preferences for a wind park are more likely to accept projects with financial benefits than projects without them.

A positive correlation between financial benefits and community acceptance is not always found because some citizens are not willing to make trade-offs between the attributes of wind energy projects, or simply because financial benefits cannot balance related costs and profits. Quantitative and qualitative studies point out that this situation especially applies to project opponents. Further, opponents could perceive financial benefits as confirmation that a project will generate high personal costs, and therefore increase their resistance. The second hypothesis of this study is therefore as follows:

H2. Wind park opponents perceive projects without financial benefits as more acceptable than projects with them.

It is arguable whether the additional distributional effect of financial benefits is a critical factor for proponents in terms of their attitudes to wind energy. The generally positive perspective of local wind energy projects could indicate that wind energy is not seen as a burden, and thus there is nothing to balance, or that other aspects of wind energy neutralize undesired project characteristics. Instead, other motives, like internal rewards generated by the satisfaction of supporting wind energy, might be

more critical. Monetary incentives could destroy this feeling and lead to small, zero, or even negative gains in the acceptance of wind energy. The third hypothesis of the study tests this assumption:

H3. Introducing financial benefits reduces proponents' acceptance of wind energy projects.

Table 1: Assumed role of distribution of costs and profits in community acceptance of proponents, opponents, and citizens with weak preferences.

	Proponents	**Citizens with weak preferences**	**Opponents**
Role of distribution	Costs and profits are distributed fairly evenly without financial benefits	Distribution of costs and profits is of concern	Costs and profits are not distributed fairly even with financial benefits
Role of benefits	Rather unnecessary and potentially undermine intrinsic motivation for supporting wind energy	Benefits make project fairer and thereby increase acceptance of wind energy	Potentially strengthen opposition to wind energy

3. Methods

3.1. Survey design

This study used an online survey that included a CBC. The study consisted of several parts that were aimed at assessing (i) the level of acceptance of wind energy, (ii) the utility of financial benefit models (from the CBC), (iii) emotions and attitudes towards wind energy and financial benefits, and (iv) collecting psychographic and demographic data from the respondents. The subject was a hypothetical wind energy project, and the utility of financial benefit models was used to assess changes in the acceptance of wind energy projects. Respondents' answers to questions about attitudes toward wind energy and financial benefits provided information about whether benefits increase perceived distributive justice.

The study used respondents' answers regarding acceptance of wind energy to segment respondents into groups with similar characteristics. Table A.1 provides an overview of the questions that were used. Figure 1 illustrates the structure of the survey and the segmentation approach.

A four-item scale assessed the initial level of acceptance of wind energy. The four items were: (i) respondents' general acceptance of wind energy in Germany, (ii) acceptance

of local wind energy near respondents' homes, and (iii) level of acceptance of two project proposals for a local wind farm (see Table A.1). The study assessed the level of acceptance at different times during the survey, and also used a broad assessment of general wind energy acceptance through votes for specific projects. For all items a seven-point Likert scale was used to measure level of acceptance. The Cronbach's Alpha for the four-item scale is 0.81, which, according to George and Mallery (2002), proves its utility.

The three level acceptance scale of Meyerhoff et al. (2010) was adapted to segment the respondents based on their answers using the four-item scale into (i) citizens who are strongly against wind energy ('opponents'), (ii) citizens who have weak opinions about wind energy ('weak preferences'), and (iii) citizens who are strongly in favor of wind energy ('proponents'). The categories use the following classification concerning the seven-point Likert scale (-3 = strongly oppose, 3 = strongly in favor): opponents (-3 to -1.5), citizens with weak preferences (>-1.5 to > 1.5), and proponents (1.5 to 3).

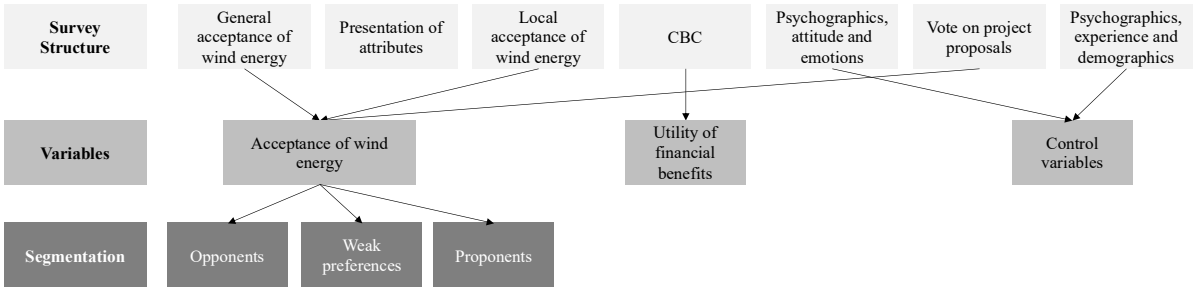

Figure 1: Structure of survey, variables, and segmentation of the sample.

The study additionally assessed attitudes toward financial participation – i.e. perceptions of the appropriateness and distributive fairness of financial benefits – and emotions toward wind energy on a seven-point Likert scale (see Table A.1). Respondents who (i) strongly or weakly accepted local wind energy (see the second question about the acceptance of wind energy in Table A.1) were asked whether they think financial participation is appropriate, and if the costs and profits of wind energy are fairly distributed without the use of benefits. Respondents who (ii) stated that they have a low level of acceptance of local wind energy were asked whether they think financial participation is inappropriate, and whether the costs and profits of wind energy are not fairly distributed even with the use of benefits. To compare opponents and proponents, the study reversed the answers on the seven-point Likert scale of opponents about the appropriateness of financial participation (see results in Table 5).

3.2. Choice-based conjoint analysis

The study applied choice-based conjoint (CBC) analysis (Sawtooth Software, 2017) as part of the online survey. CBC analysis originates from mathematical psychology, where it was used to elicit individual preferences. First described by Kruskal (1965) and Luce and Tukey (1964), the method, along with conjoint analysis and factorial experimental surveys, is a multifactorial experiment (Auspurg and Hinz, 2015).

CBC analyses are regularly used to analyze citizens' preferences and acceptance of renewable energies – for example, the community acceptance of wind energy (Strazzera et al., 2012), preferences for electricity-saving programs (Hille et al., 2019), willingness to accept wind farm externalities (Brennan and Van Rensburg, 2016), and willingness to accept wind energy exports (Brennan and van Rensburg, 2020). Here, the CBC analysis is used to analyze the effect of financial benefits on community acceptance in relation to wind energy projects. The part-worth utilities of the wind project's attributes function as an indicator of the increase in community acceptance in this study. Based on Lancaster's (1966) theory of consumer behavior, this study assumes that higher part-worth utilities of benefits compared to no benefits indicate that benefits increase community acceptance.

In a CBC analysis, respondents are placed in a hypothetical but realistic choice situation, such as the selection of an electricity tariff or investment option (Tabi et al., 2014; Salm et al., 2016). Respondents are presented with different alternatives (e.g. products, services, etc.) that are associated with their most important attributes (e.g. price, and brand) and levels (e.g. high price and low price, branded and non-branded goods). Each alternative varies only in terms of the level. The task is repeated several times and respondents thus make repeated choices between different alternatives. The attribute levels are systematically varied between the rounds as well as across respondents.

Comparing the choices enables the researcher to elicit respondents' underlying preferences according to Lancaster's (1966) theory of consumer behavior. This assumes that respondents maximize their utility when comparing different alternatives. The utility obtained from an alternative is the linear sum of the (part-worth) utilities of each attribute of the alternative ("product as a bundle") (Lancaster, 1966). Hierarchical Bayes (HB) estimation is used to derive them and attribute importance in this study (Huber and Train, 2001; Rossi and Allenby, 2003). HB models are better than other

models at handling respondents' heterogeneity and the variability of preferences among respondents (Sawtooth Software, 2009).

In the present study, the CBC analysis assessed preferences concerning a hypothetical wind park close to the respondents' hometown. Respondents were presented with three different alternatives and selected their preferred wind energy project. They repeated this task eight times, resulting in eight choice tasks. The alternatives consisted of five attributes, each featuring four levels (see Table 2). These represented the most important factors of wind energy projects relevant to this study, and were based on real project characteristics. Each alternative displayed all attributes, but only showed one level per attribute at a time. The choice tasks were thus unique because levels varied between rounds. The study used Sawtooth Software to generate the CBC analysis, with 300 different choice sets, each consisting of eight tasks, three alternatives, and varying attribute levels.

Benefits are of special interest in this study. They can take the form of rewards (funds and in-kind contributions) and discounts (e.g. on an electricity tariff) (Barrera-Hernández et al., 2016). The financial benefits models in the CBC analysis used in this study are (1) discounted electricity tariff (community electricity tariff for 150 households per turbine, equivalent to roughly 20,000 € per year and turbine), (2) municipal funds (20,000 € per year and turbine to the municipality), (3) social funds (20,000 € per year and turbine for social purposes) and (4) no benefits. The attribute level "no benefits" functions as a benchmark. The models are based on benefits that different European countries use:

1. **Payments to the municipalities**

   Approximately 25,000 € per turbine site is paid as a reward to municipalities in Denmark (Barrera-Hernández et al., 2016). Benefits are rather new in Germany as part of the revised German 2021 Renewable Energy Sources Act (§ 36k). The only benefit model that was included in the law is voluntary payments to a municipality. Payments can be up to 0,2 Cent/kWh, amounting to roughly 20,000 € per turbine per year. Benefit payments are voluntary in England. The design of particular schemes is subject to negotiations between the developer and the community (Regen, 2014).

2. Payments for social purposes (in-kind)

In-kind benefits in the UK are payments made to visitor recreation facilities, job creation facilities, and for environmental improvements. Bristow et al. (2012) identified the community benefit provision schemes of wind farm developments in Wales, which are also largely a matter of negotiation. A wide variety of benefits are also used in Scotland (Macdonald et al., 2017).

3. Payments to citizens (discounts and compensation)

Local electricity discount schemes can be negotiated in the UK between the local community and the project developer. This means that citizens who live close to turbines receive a discount on their electricity bill. An alternative that is used, for example, in Germany, is a special electricity tariff that only citizens in the local vicinity of wind turbines may receive.

Table 2: Attributes and levels used in the choice-based conjoint analysis. The table is a brief summary. Appendix A illustrates how the survey presented attributes and levels to respondents.

Attribute	Attribute level
Number of wind turbines	3
	7
	11
	15
Distance between houses and wind turbine(s)	500 m
	1,000 m
	1,500 m
	2,000 m
Financial benefits	No benefit
	Social funds: Payment for social purposes (20,000 € wind turbine/year)
	Municipal funds: Payment to municipality (20,000 € wind turbine/year)
	Discounted electricity tariff: 10% discount on basic tariff for 150 households/turbine, equivalent to approximately 20,000 € wind turbine /year
Developer	Individuals (Single persons)
	Pension funds
	Regional public utility
	National energy corporation
Location	Landscape protected area
	Forest
	Agricultural land
	Industrial and commercial area

3.3. Data sample

The survey was pretested before it was sent to respondents to verify that it was understandable and clear (e.g., with respect to attributes and levels). The author asked respondents in the pre-test to complete the survey and to voice any questions, concerns, and ambiguities when communicating via telephone or videoconference. The pre-test respondents were not part of the final sample.

A market research agency implemented the online survey in August 2020, including recruiting and paying the respondents for taking part. Respondents who did not fill out the whole survey for reasons like not complying with the quotas (age, gender, and region) or who failed the attention test were excluded from the sample. One thousand German respondents filled out the whole survey. After removing flatliners and speeders, which accounted for 189 respondents, the final sample numbered 811. It was then segmented to help address the research question and test the hypotheses. Respondents needed a median of about nine minutes to answer the survey.

The segmentation reveals that 408 of the respondents have weak preferences (50%) in relation to wind energy, 352 are proponents (43%), and opponents only account for a small minority of 51 respondents (6%). The level of acceptance of wind energy for the final sample (n = 811) is 4.99 on a seven-point Likert scale. These numbers are in line with the findings of other surveys like FA Wind (2020).

All segments were tested for significant differences with respect to emotions, attitude towards financial participation, general and specific experience with wind energy, and psychographic and demographic data using Mann Whitney U tests for interval and ordinal and Chi squared tests for categorical variables.

There is no significant difference in terms of age between the segments, unlike gender and geographical center of life (see Table B.1). Women are more critical of wind energy projects than men. The share of proponents is relatively high in the western and southern parts of Germany. Opponents are relatively numerous in the eastern part. Overall, the sample is representative of the German population concerning age, gender, and region.

Differences in customer behavior are significant between the segments (see Table B.2). Proponents buy more renewable electricity than opponents, and they are more likely to be members of an environmental organization. Proponents furthermore claim to live the most environmentally friendly lifestyles and are willing to pay more for environmentally friendly products. Opponents and proponents pay closer attention to

conditions of production, like child labor. Socioeconomic variables like income, education, and home ownership had no significant influence on segment membership.

Opponents and proponents both state that they have more experience with wind energy than citizens with weak preferences (see Table B.2). The share of respondents who had been actively involved with wind energy is less than 10%. Fewer than 3% of proponents and citizens with weak preferences have had any financial involvement with wind turbines.

3.4. Data analysis of the CBC

The study tested whether the CBC results were significantly different between and within segments. Specifically, the study used Mann-Whitney U tests to examine the differences between and within segments with respect to the average importances of attributes. Bayesian tests were used to check for statistically differences between levels within attributes and segments. Both tests compare attributes and attribute levels pairwise, which means that the analysis undertook a series of comparisons that considered only two attributes or two attribute levels each time until all possible combinations had been checked (see Figure 2).

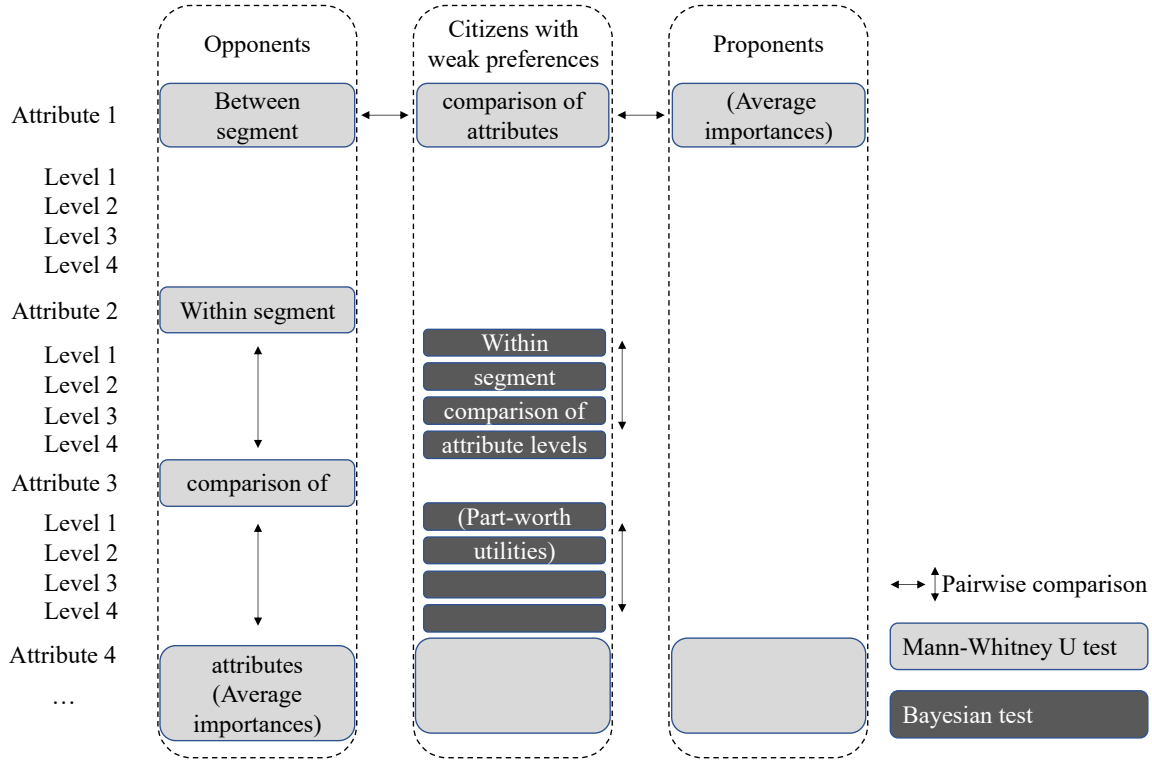

Figure 2: Statistical tests for the CBC results. The study used Mann-Whitney U and Bayesian tests to compare, pairwise, whether attributes and attribute levels are statistically significantly different between and within segments.

Both tests check whether one value is statically significantly greater than another value. The Bayesian test examines the degree of confidence that one level is greater than another through a different approach to a frequentist Mann–Whitney U test. It determines the degree of confidence by counting (Orme and Chrzan, 2017). The test takes as its starting point the HB estimation procedure, which consists of two levels – an upper or population level and a lower or individual level (Sawtooth Software, 2009). The HB estimation procedure involves thousands of iterations between the upper and lower levels before providing the final coefficient estimates. Sawtooth records these cycles and stores them. The HB estimation procedure in this study involved a total of 20,000 iterations that resulted in 20,000 alpha (for the upper level) and 20,000 beta draws (for the lower level). The first 10,000 alpha draws were discarded because convergence is assumed to be reached thereafter (Orme and Chrzan, 2017). The study obtained the results of the Bayesian tests through counting for how many of the remaining 10,000 alpha draws the estimate of the part-worth utility is larger for one level than another. The sum of counts in which one alpha draw is greater than another indicates the confidence that one level is greater than another.

4. Results

The following sections report the results of this study. First, they show the importances of the attributes of the CBC analysis to assess the relevance of financial benefits for wind energy projects compared to other attributes like distance and location. Next, the study focuses on one attribute, financial benefits, and analyses the impact of the level thereof to test the hypotheses. The study distinguishes between the preferences of wind energy opponents, proponents, and citizens with weak preferences at all steps to elaborate the role of financial benefits on community acceptance.

4.1. Average importances of attributes and part-worth utilities of attribute levels

Table 3 presents the average importances of the attributes of the hypothetical wind energy project for proponents, opponents, and citizens with weak preferences. The average importances represent the weight that an attribute has, on average, in a respondent's decision.

Location is the most important attribute for all segments, followed by distance, when ranking the average importances of the attributes from high to low. Financial benefits

rank third for supporters and citizens with weak preferences, and fourth for opponents. The number of turbines and the project developer tend to be relatively unimportant for all segments. The following sections examine whether these differences between segments and within segments are statistically significant.

Table 3: Average importances and standard deviations of attributes.[a]

Attribute	Proponents (N=352)		Citizens with weak preferences (N=408)		Opponents (N=51)	
	Average importances	Standard deviations	Average importances	Standard deviations	Average importances	Standard deviations
Number of turbines	11%	5.2	12%	7.6	14%	4.8
Distance	22%	10.3	24%	12.7	29%	16.9
Financial benefits	21%	8.8	14%	6.4	11%	5.9
Project developer	17%	7.5	11%	6.6	8%	3.2
Location	30%	12.0	38%	17.3	38%	18.2

[a] Due to rounding errors, cumulated percentages may not sum to 100%

4.1.1. Pairwise comparison of attributes within segments

Mann-Whitney U tests were undertaken to test whether one attribute is statistically significantly more important than another for each segment separately – e.g., between location and project developer. Most attributes are significantly different important, which means, for example, that location (the attribute with highest average importance) is significantly more important than distance (the attribute with the second highest average importance) for all segments. There are two exceptions regarding statistical significance in the pairwise comparisons. The differences between benefits and the project developer for opponents and between benefits and distance for proponents are not statistically significantly different (for reasons of clarity, the results of the tests have not been included as a table in the paper. Data are available from the author upon request and were provided to the reviewers).

4.1.2. Pairwise comparison of attributes between segments

Chapters 4.1 and 4.2 show that the attributes are ranked quite similarly for all segments in terms of attribute importances on a scale of one to five, with minor exceptions. However, this does not mean that the attributes are similarly important between segments. The pairwise comparison between segments shows that, especially when comparing opponents and proponents, the attributes are not similarly important (see

Table 4). For example, location is statistically significantly more important for opponents than for proponents, and the project developer is statistically significantly more important for proponents than for opponents. This means that project developers who want to increase project acceptance need to consider different attributes depending on which segment they want to focus on.

Table 4: Pairwise comparison of average importances between segments. Citizens with weak preferences sometimes share preferences with opponents and sometimes with proponents. For example, location is almost equally important to opponents and citizens with weak preferences, but not to proponents. In contrast, the number of turbines is almost equally unimportant to citizens with weak preferences and proponents, but not to opponents.

Pairwise comparison of segments	Number of turbines	Distance	Financial benefits	Project developer	Location
Opponents – Proponents	***	***	***	***	***
Opponents – Citizens with weak preferences	***		***	***	
Proponents – Citizens with weak preferences		**	***	***	***

***Average importances differ at a significance level of .01 between segments.
** Average importances differ at a significance level of .05 between segments.

4.2. Profiling opponents, proponents, and citizens with weak preferences

This section considers in more detail financial benefits and how preferences differ between opponents, proponents, and citizens with weak preferences. Financial benefits rank third based on the average attribute importance for proponents and citizens with weak preferences compared to the other four attributes. For opponents, financial benefits are only ranked fourth. This means that especially proponents and slightly less also citizens with weak preferences consider financial benefits as important when comparing different project features.

Differences in preferences between the segments are also apparent when looking at the different models of financial benefits. Figure 3 and Table B.3 present the part-worth utilities for wind energy opponents, proponents, and citizens with weak preferences. The utilities for each attribute and segment are rescaled with the lowest attribute level set at zero. Table B.4 reports the results of the Bayesian test, which tested whether one attribute level is statistically significantly greater than another.

First, among all four attribute levels, citizens with weak preferences for local wind energy projects statistically significantly prefer the discounted electricity tariff the most. Collective benefits like the municipal and social funds rank second and third. Having no benefits is the least preferred option. All differences are statistically significant. The reason for a preference for discounted electricity over no benefits could be distributive justice. Citizens with weak preferences could perceive a project with discounted electricity to be fairer than one without. They may think it is fair that citizens that live closest to an installation have more right to receive benefits, thus they prefer an option that includes discounted electricity for citizens that live in proximity to a turbine. In contrast, all citizens equally benefit from payments to social purposes or the municipality, including those who are not affected. Thus, it is possible that payments for social purposes or the municipality are not seen as a means of sharing costs and profits fairly.

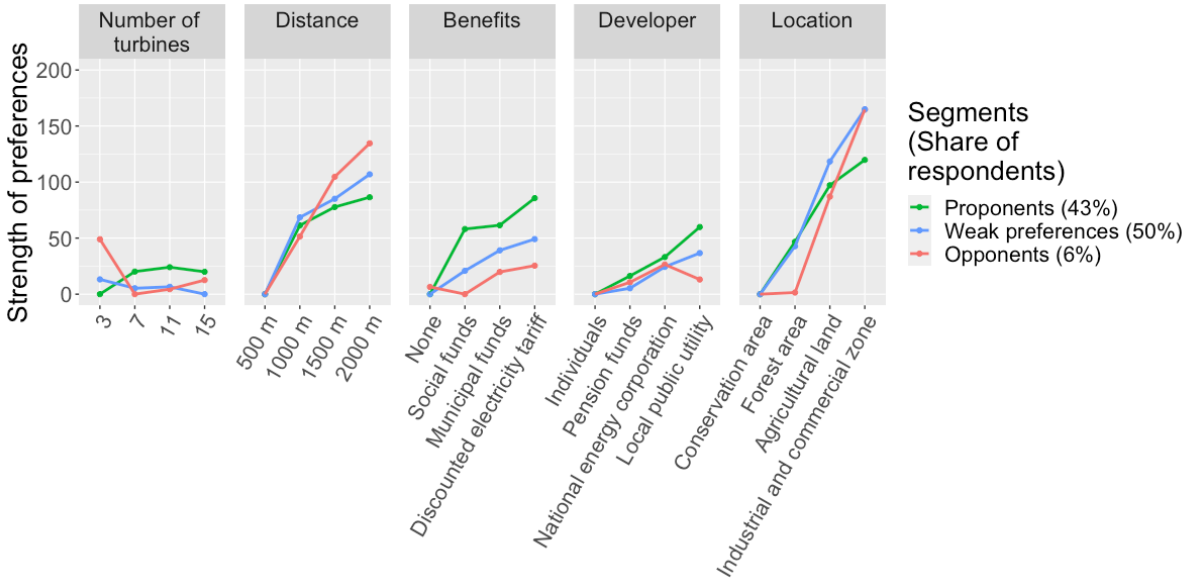

Figure 3: Part-worth utilities from the CBC analysis for proponents, opponents, and citizens with weak preferences. The y-axis "strength of preferences" shows the part-worth utility values for all attribute levels. Starting from the level with the lowest utility for each attribute and segment (fixed at value 0), the values on the y-axis show how much more utility the other three levels of the same attribute derive for all segments in comparison.

While benefits may increase perceived fairness, the survey shows, statistically significantly, that the inclusion of benefits is not enough to balance the costs and profits of wind energy and thereby ensure a perception of overall distributive fairness (see Table 5). Apparently, citizens with weak preferences would accept benefits if they were offered them, but do not see them as sufficient to ensure fair distribution. Their rather neutral opinions concerning whether financial participation is appropriate

further question whether benefits alone may persuade citizens with weak preferences to support a wind energy project. Benefits may help increase acceptance, but project developers should accompany them with other incentives. Thus, this study does not permit the rejection of Hypothesis 1, that *"citizens with weak preferences for a wind park are more likely to accept projects with financial benefits than projects without them."*

Table 5: Emotions of respondents in relation to wind energy and attitudes towards financial benefits.

		Opponents (N = 51)	**Weak preferences (N = 408)**	**Proponents (N = 352)**
Emotions towards local wind energy projects	Joy***	1.5 (1.1)	3.9 (1.4)	5.2 (1.3)
	Curiosity***	1.7 (1.1)	4.1 (1.5)	5.2 (1.3)
	Anger***	5.5 (1.8)	2.9 (1.4)	2.1 (1.6)
	Fear***	4.9 (1.8)	3.1 (1.5)	2.2 (1.5)
Attitude towards financial benefits	Financial participation is appropriate***	2.6 (1.8)	3.9 (1.4)	4.6 (1.5)
	Advantages and disadvantages are fairly distributed even without benefits***	- [1]	3.8 (1.1)	4.2 (1.3)
	Advantages and disadvantages are not fairly distributed even with benefits***	6.0 (1.4)	(1.2)	- [1]

[1] Question was not presented to this group

*** Significant between the three segments at the 1% level.

** Significant between the three segments at the 5% level.

* Significant between the three segments at the 10% level.

Second, the gain in utility due to benefits compared to no benefits is relatively small for opponents, and not significant for all levels. A discounted electricity tariff is preferred most. Municipal funds and no benefits rank second and third. Social funds have a lower utility than having no benefits. However, only the differences between discounted electricity and (1) no benefits and (2) social funds are statistically significant.

This trend partly reflects what the literature reports. The offer of benefits does not win over opponents of wind energy projects, as expected. However, the results of the CBC analysis do not identify a significant negative effect of financial benefits on opponents' acceptance. This is surprising for two reasons. First, opponents agree (statistically significantly) that financial participation is not appropriate. Second, opponents state (also significantly) that benefits do not help with the fair distribution of wind energy profits and costs.

While the utilities of the benefit models are rather small and thus make interpretation more challenging, the potentially negative effect of financial benefits associated with payments for social purposes is only slight and not significant. Results here show that financial benefits do not make wind energy more unacceptable to its opponents. Hypothesis 2, *"wind park opponents perceive projects without financial benefits as more acceptable than projects with them"* is thus rejected.

Third, the third hypothesis of this paper involves proponents. This group shows a significant preference for discounted electricity, municipal funds, and social funds, which are ranked first, second and third in desirability, respectively. The gain in the utility of benefits is larger than with the other two segments. This suggests that financial benefits increase the acceptance of proponents even more than for citizens with weak preferences.

These findings do not reflect the initial assumptions of this study, which presumed the identification of only a small, zero, or even negative gain in acceptance due to the decline in intrinsic motivation. The opinion of proponents that financial participation is appropriate probably compensate for potential losses of intrinsic motivation. The fear of crowding-out is unfounded. Hypothesis 3, *"introducing financial benefits reduces proponents' acceptance of wind energy projects,"* is thus rejected.

All segments show statistically significant differences in their emotions towards wind energy. Whether these emotions are generally associated with the technology, or were generated by the structure of the survey cannot be verified at this point. However, other work, such as that of Cousse et al. (2020) also reported comparable differences in emotions. This could be an indication that attitudes toward wind energy and emotions toward turbines are generally correlated.

5. Conclusions and Policy Implications

Opposition to wind energy creates challenges to increasing the share of renewable electricity in the energy mix. Policy makers see combining wind energy installations with financial benefits for local communities as a means of counteracting opposition. The study described here analyzed, through a choice-based conjoint analysis among 811 German residents, how citizens perceive financial benefits in wind energy projects, and addressed the question whether offering benefits may fulfill the hope of increasing acceptance.

Literature about financial participation finds a generally positive effect of benefits on acceptance. However, as Brennan and Van Rensburg (2016) and Walter (2014) show, some people are not willing to accept them, and moreover, benefits may increase reservations about projects. The literature so far has not accounted for the potential threat of reducing acceptance through offering benefits using a quantitative study, thus this study helps close this research gap.

5.1. General conclusion

The experimental setting of this study helped identify that benefits can increase acceptance, but not for all people equally. Citizens who have weak preferences concerning local wind energy projects significantly prefer all types of benefits over having no benefits, indicating that they potentially perceive financial benefits as a positive add-on to projects and are therefore more accepting of them. The hypothesis that members of this large group of citizens are more likely to accept projects with financial benefits than projects without them could not be rejected.

Not all financial benefits increase the support of opponents. Opponents perceive some benefits as advantageous, but the effect on the acceptance of wind projects is relatively small and, in most cases, not statistically significant. Citizens that support projects significantly appreciate benefits. This is encouraging, as there have been empirical observations in related fields that financial incentives can crowd-out the motivation of proponents of a cause due to their altruism (Titmuss, 1970). The offer of financial benefits in these studies, however, has been identified to result in a loss of support of people who were already in favor. Apparently, this is not the case for wind energy. Benefits do not crowd-out the support of wind energy proponents.

5.2. Policy Implications

The results suggest five implications for energy policy. First, financial benefits are indeed a way to increase community acceptance of local wind energy projects. This conclusion supports current policies that enable the use of financial benefits. Second, the motivation of people who already support wind energy is not crowded out by offering benefits. Policy makers must not fear that they will lose the support of citizens with strong intrinsic support for wind energy. The opposite is the case. Third, benefits may play a key role in winning over citizens with weak preferences for local projects. This is critical, because this group comprises a large share of the local community and

their support is necessary for winning over a majority. Fourth, the offer of benefits does seem not to persuade opponents. Fifth, policy makers should enable a wide variety of different benefits so that project developers can choose the appropriate model for their particular project. Concerning the German context, the next revised version of the renewable energy act and energy market design should enable the deployment of a discounted electricity tariff because this benefit model is more appealing to proponents and citizens with weak preferences than payments to the municipality.

In terms of implications for project developers, the research suggests that offering benefits is another option for increasing community participation, but also that they are insufficient for ensuring the perception of fair distribution. While the use of benefits is already known in the United Kingdom and Ireland, it is rather new in German legislation. Project developers can investigate different models and select those which fit the local context.

In addition, project developers may consider changing other project features, such as the distance between residences and turbines, or the location of turbines. Increasing the distance by a few hundred meters and siting turbines on agricultural land instead of forested areas may also have a strong impact on acceptance. This might be especially important when reaching out to opponents of wind energy (who might still oppose a project if project developers increase the distance or choose a different site, but their willingness to actively oppose a project could be decreased). The disadvantage of a more distant or different site may be that less land is available and/or the wind speed is lower, which could result in higher project costs. However, there is no magic formula – certainly not one that affects all citizens equally, and financial benefits are only one of the 'adjustment screws' that project developers can turn.

5.3. Limitations and further research

The first limitation of the research described here concerns the method of data gathering. It seems in general that revealed preference methods lead to weaker evidence of crowding-out effects than when using an experimental approach (Boberg-Fazlić and Sharp, 2017). Attempts were made to overcome this limitation by using a choice-based conjoint analysis. This method indirectly measures preferences, instead of directly asking how respondents perceive benefits. It is therefore probably less biased. Respondents were not made aware of the method and research question of the study, which might have reduced the impact of manipulation.

The second limitation concerns the experimental design, which focuses on the initial reactions of citizens at the moment they are offered financial benefits for the first time. However, the acceptance of financial benefits can change over time. People may be more reluctant to accept financial benefits initially, but this can change when they become more familiar with the idea of receiving a reward. Alternately, benefits could also increase resistance when there is a low level of trust in the project developer.

Understanding whether and how benefits enable or disable active opposition is beyond the scope of this paper. The same applies to revealing how different segments interact – for example, how opponents or proponents influence citizens with weak preferences. Here, not only benefits but also other attributes such as distance and location could have an activating effect. Investigating dynamics over time, between segments, trade-offs between attributes and levels, and the effect of other variables (procedural justice, trust, and sympathy toward the project developer) would be a worthwhile research project. In addition, examining the effect of monetizing the cost of tradeoffs (e.g., greater distance versus more financial benefits) would be an interesting research topic.

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Appendix

Appendix A.

Introductory text to respondents:

Please imagine that a wind farm is planned near **your community**. Various **information events** and **hearings** have already taken place. Progress is regularly reported in the **media**.

Many **details** have not yet been finalized. The municipality has identified **several possible sites** for the wind farm. **Environmental impact assessments** and **wind measurements** have been successfully carried out for all options. The wind turbines could produce **renewable electricity at a low cost**. Imagine that the municipality wants to **involve** you **more** in the planning process. The following pages serve this purpose. The process is as follows: You will first be given some background information on the potential wind farm. Then you will be asked for your opinion.

Presentation of the attributes and levels of the CBC to the respondents:

As mentioned before, the municipality wants you to be involved in the decision about the **potential wind farm**. You can influence the following wind farm properties. Please **read** the Information **carefully** before proceeding. You will **need** the information for the rest of the survey.

Possible number of wind turbines:

- 3
- 7
- 11
- 15

For your information: One wind turbine produces about 6 GWh of electricity annually. This corresponds to the demand of about 2,000 households. The hub height of the wind turbine is 150 m. All options are ecologically and economically reasonable.

Possible distance of the nearest wind turbine to the settlement:

- 500 m
- 1,000 m
- 1,500 m
- 2,000 m

For information: A settlement is a collection of at least five residential buildings.

Possible financial benefits (wind cent):

- No benefit (wind cent)
- Citizen electricity tariff with a 10% discount compared to the local basic utility tariff. For each wind turbine, 150 households receive this discounted electricity tariff. Priority is given to households living closest to the wind farm.
- 20,000 € per year and turbine to municipality
- 20,000 € per year and turbine to a fund that supports associations, social institutions and environmental protection projects

For information: The wind project developer pays a wind cent, in addition to any compensation payments (e.g. for interventions to nature), that are otherwise incurred. This procedure is comparable to the practice of the water cent that is applied to the abstraction of groundwater and surface water.

Possible project developer:

- Individuals (Single persons)
- Pension funds
- Regional public utility
- National energy corporation

For information: The project developers are carrying out the project. They own the wind farm.

Possible location of the wind farm:

- Landscape protected area
- Forest
- Agricultural land
- Industrial and commercial area

Table A.1 lists the variables used in the survey and how it presented them to respondents.

Table A.1: Formulations of survey items.

Variable	Value	Question in survey
Acceptance of wind energy	General acceptance of wind energy	Please assess your attitude towards the topic of wind energy in Germany.
	Acceptance of local wind energy	Please rate your attitude towards the topic of wind energy in your region.
	Vote on local wind energy project	How likely is it that you would vote for the following projects?
Emotions	Joy	When I think of local wind energy projects, I feel joy.
	Curiosity	When I think about local wind energy projects, I feel curiosity.
	Anger	When I think of local wind energy projects, I feel anger.
	Fear	When I think of local wind energy projects, I feel fear.
Attitude towards financial participation	Appropriateness of financial participation	I think financial participation is appropriate.
	Fair distribution of advantages and disadvantages (proponents and neutral)	Advantages and disadvantages of local wind energy projects are evenly distributed without wind cents.[a]
	Fair distribution of advantages and disadvantages (opponents)	Advantages and disadvantages of local wind energy projects are unfairly distributed even with wind cents.

[a] A wind cent is a hypothetical resource tax. It is paid for the use of wind, similar to the German tax on the use of groundwater and surface water in nuclear and coal-fired power plants.

Appendix B.

Table B.1: Demographics of sample.[a]

Variable	Value	Opponents (N = 51)	Weak preferences (N = 352)	Proponents (N = 408)	Total sample (N = 811)	German Population[b]
Level of acceptance		2.27	4.78	6.21	4.99	
Age	18 – 29	8%	14%	18%	16%	16%
	30 – 39	6%	13%	16%	14%	16%
	40 – 49	20%	15%	11%	14%	15%
	50 – 59	27%	20%	18%	20%	19%
	60 – 69	16%	16%	16%	16%	15%
	70 – 90	24%	20%	22%	21%	19%
Gender***	Women	55%	58%	37%	49%	49%
	Men	45%	42%	63%	51%	51%
Region***	North	14%	16%	18%	17%	16%
	East	33%	24%	13%	20%	20%
	West	25%	36%	37%	36%	35%
	South	27%	24%	32%	28%	29%

[a] Due to rounding errors, cumulated percentages may not sum to 100%.
[b] Data from Statistisches Bundesamt (2020a, 2020b, 2020c)
*** Significant differences between segments at the 1% level.
** Significant differences between segments at the 5% level.
* Significant differences between segments at the 10% level.

Table B.2: Experience, customer behavior, and demographics of the sample.

Variable	Value	Opponents (N = 51)	Weak preferences (N = 408)	Proponents (N = 352)
Experience with wind energy	No experience***	20%	34%	22%
	From media***	45%	31%	48%
	Have seen turbines close up***	57%	46%	54%
	Can see turbines from home**	25%	13%	16%
	Have turbines in region***	45%	25%	36%
	Actively participated	10%	5%	9%
	Involved financially	0%	1%	3%
Customer behavior	Buy renewable electricity ***	25%	30%	47%
	Member of environmental organization**	2%	3%	6%
	Live in environmentally friendly way**	49%	45%	54%
	Willing to pay more for environmentally friendly products***	29%	22%	33%
	Pay attention to manufacturing conditions *	39%	29%	36%
Net income of household[a]	under 1,000 EUR	12%	8%	9%
	1,000–1,499 EUR	10%	13%	9%
	1,500–1,999 EUR	14%	15%	15%
	2,000–2,499 EUR	10%	15%	15%
	2,500–3,499 EUR	20%	20%	23%
	more than 3,500 EUR	24%	20%	25%
Education[a]	general school (*Hauptschule*) without apprenticeship	2%	2%	2%
	general school (*Hauptschule*) with apprenticeship	12%	13%	13%
	secondary school-leaving certificate (*Mittlere Reife*)/ secondary school without *Abitur*	39%	32%	29%
	Abitur/higher education entrance qualification without undergraduate studies	22%	22%	22%
	university degree (university, college, technical college, academy, polytechnic)	24%	31%	32%
	Education, still at school	0%	0%	0%
	Education, other	0%	0%	0%
	under 2.000	10%	10%	9%

Inhabitants of community of residence[a]	2,000-5,000	18%	10%	10%
	5,000-2,000	20%	21%	22%
	20,000-50,000	18%	17%	17%
	50,000-100,000	10%	10%	10%
	100,000-500,000	12%	16%	14%
	more than 500,000	14%	17%	16%
Demographics	Household size	2.1 (0.9)	1.9 (1.0)	2.2 (1.2)
	Minor	1.2 (0.6)	1.2 (0.6)	1.3 (0.7)
	Living in a single-family or terraced house	45%	36%	42%
	Homeowner	47%	38%	45%
	Rural	37%	42%	45%

[a] Due to rounding errors, cumulated percentages may not sum to 100%.

∗∗∗ Significant differences between segments at the 1% level.

∗∗ Significant differences between segments at the 5% level.

∗ Significant differences between segments at the 10% level

Table B.3: Zero-centered utilities, standard deviations, and lower and upper 95% confidence interval. (hierarchical Bayes model with normally distributed utilities) for opponents, proponents, and citizens with weak preferences.

		HB model opponents (N = 51)			HB model weak preferences (N = 408)			HB model proponents (N = 352)		
Attribute	**Attribute level**	**Zero-centered utilities**	**Lower and upper 95% Cl**	**Standard deviations**	**Zero-centered utilities**	**Lower and upper 95% CI**	**Standard deviations**	**Zero-centered utilities**	**Lower and upper 95% CI**	**Standard deviations**
Number of turbines	3	32.5	[27.7:37.2]	17.3	6.9	[3.7:10.1]	33.0	-16.0	[-18.4:-13.7]	22.1
	7	-16.5	[-23.0:-10.0]	23.7	-1.0	[-3.1:1.1]	21.7	4.1	[1.9:6.3]	21.1
	11	-12.1	[-18.1:-6.1]	21.9	0.3	[-2.1:2.7]	24.5	8.0	[5.9:10.2]	20.5
	15	-3.9	[-8.7:0.8]	17.2	-6.3	[-9.1:-3.4]	29.7	3.9	[1.7:6.1]	21.4
Distance	500 m	-72.7	[-82.5:-62.9]	35.6	-65.1	[-69.7:-60.6]	46.6	-56.4	[-60.2:-52.6]	36.0
	1,000 m	-21.3	[-31.9:-10.6]	38.7	3.4	[1.9:4.9]	15.2	4.9	[2.3:7.6]	25.2
	1,500 m	32.1	[26.2:37.9]	21.2	20.0	[17.3:22.7]	27.8	21.3	[19.2:23.5]	20.9
	2,000 m	61.9	[44.9:78.8]	61.7	41.8	[38.4:45.2]	34.8	30.1	[25.9:34.3]	39.8
Benefits	None	-6.5	[-13.5:0.6]	25.6	-27.3	[-30.0:-24.6]	28.0	-51.3	[-54.9:-47.7]	34.3
	Social funds	-12.9	[-17.7:-8.2]	17.3	-6.4	[-8.7:-4.2]	23.3	6.8	[4.4:9.2]	23.0
	Municipal funds	6.9	[0.2:13.5]	24.3	11.8	[9.6:14.0]	22.5	10.2	[7.4:13.0]	26.9
	Discounted electricity tariff	12.5	[6.2:18.9]	23.2	21.9	[19.8:23.9]	21.2	34.3	[31.0:37.6]	31.7
Developer	Individuals	-12.5	[-16.4:-8.7]	14.0	-16.6	[-18.8:-14.4]	22.9	-27.3	[-30.5:-24.1]	30.9
	Pension funds	-1.9	[-6.0:2.2]	14.9	-11.3	[-13.3:-9.4]	20.1	-11.1	[-13.9:-8.3]	26.8
	National energy corporation	13.9	[10.0:17.9]	14.3	7.8	[5.9:9.7]	19.9	5.8	[3.2:8.5]	25.3
	Regional public utility	0.5	[-3.3:4.3]	13.8	20.1	[18.1:22.1]	20.6	32.6	[29.6:35.5]	28.4
Location	Landscape protected area	-63.3	[-73.5:-53.1]	37.1	-81.5	[-86.4:-76.7]	50.0	-65.9	[-71.1:-60.8]	49.2
	Forest	-61.9	[-73.9:-49.8]	44.0	-38.8	[-43.4:-34.2]	47.2	-19.2	[-23.0:-15.3]	36.6
	Agricultural land	23.8	[15.3:32.2]	30.8	36.9	[34.0:39.7]	29.5	31.2	[27.6:34.9]	34.7
	Industrial and commercial area	101.4	[81.3:121.5]	73.3	83.4	[76.6:90.2]	69.7	53.9	[48.7:59.0]	49.6

Table B.4: Bayesian tests for differences between attribute levels within segments.

Attribute	Pairwise comparison of attribute levels	Opponents	Weak preferences	Proponents
Number of turbines	3 – 7	***		***
	3 – 11	***		***
	3 – 15	***		***
	7 – 11			
	7 – 15		*	
	11 – 15		**	
Distance	500 m – 1,000 m	***	***	***
	500 m – 1,500 m	***	***	***
	500 m – 2,000 m	***	***	***
	1,000 m – 1,500 m	***	**	***
	1,000 m – 2,000 m	***	***	***
	1,500 m – 2,000 m	*	***	**
Benefits	None - Social funds		***	***
	None - Municipal funds	*	***	***
	None - Discounted electricity tariff	**	***	***
	Social funds - Municipal funds		***	**
	Social funds - Discounted electricity tariff	**	***	***
	Municipal funds - Discounted electricity tariff		***	**
Developer	Individuals - Pension funds			***
	Individuals - National energy corporation	**	***	***
	Individuals - Regional public utility		***	***
	Pension funds - National energy corporation	*	***	*
	Pension funds - Regional public utility		***	***
	National energy corporation - Regional public utility	**	***	***
Location	Landscape protected area - Forest		***	***
	Landscape protected area - Agricultural land	***	***	***
	Landscape protected area - Industrial and commercial area	***	***	***
	Forest - Agricultural land	***	***	***
	Forest - Industrial and commercial area	***	***	***
	Agricultural land - Industrial and commercial zone	***	***	***

*** Confident at the 1% level.
** Confident at the 5% level.
* Confident at the 10% level

References

Auspurg, K., Hinz, T., 2015. Multifactorial Experiments in Surveys, in: Keuschnigg, M., Wolbring, T. (Eds.), Experimente in den Sozialwissenschaften. Nomos, Baden-Baden, pp. 294-320.

Barrera-Hernández, L.K., Barton, B., Godden, L., Lucas, A.R., Rønne, A., 2016. Sharing the costs and benefits of energy and resource activity: legal change and impact on communities, First edition ed. Oxford University Press, Oxford.

Bertsch, V., Hyland, M., Mahony, M., 2017. What drives people's opinions of electricity infrastructure? Empirical evidence from Ireland. Energy Policy 106, 472-497.

Boberg-Fazlić, N., Sharp, P., 2017. Does Welfare Spending Crowd out Charitable Activity? Evidence from Historical England under the Poor Laws. The Economic Journal 127, 50-83.

Brennan, N., Van Rensburg, T.M., 2016. Wind farm externalities and public preferences for community consultation in Ireland: A discrete choice experiments approach. Energy Policy 94, 355-365.

Brennan, N., van Rensburg, T.M., 2020. Public preferences for wind farms involving electricity trade and citizen engagement in Ireland. Energy Policy 147.

Bristow, G., Cowell, R., Munday, M., 2012. Windfalls for whom? The evolving notion of 'community' in community benefit provisions from wind farms. Geoforum 43, 1108-1120.

Cass, N., Walker, G., Devine-Wright, P., 2010. Good Neighbours, Public Relations and Bribes: The Politics and Perceptions of Community Benefit Provision in Renewable Energy Development in the UK. Journal of Environmental Policy & Planning 12, 255-275.

Cousse, J., Wüstenhagen, R., Schneider, N., 2020. Mixed feelings on wind energy: Affective imagery and local concern driving social acceptance in Switzerland. Energy Res. Soc. Sci. 70.

Deci, E.L., 1971. Effects of externally mediated rewards on intrinsic motivation. Journal of Personality and Social Psychology 18, 105-115.

Deci, E.L., 1976. The hidden costs of rewards. Organizational Dynamics 4, 61-72.

Enevoldsen, P., Sovacool, B.K., 2016. Examining the social acceptance of wind energy: Practical guidelines for onshore wind project development in France. Renewable and Sustainable Energy Reviews 53, 178-184.

Evans, B., Parks, J., Theobald, K., 2011. Urban wind power and the private sector: community benefits, social acceptance and public engagement. Journal of Environmental Planning and Management 54, 227-244.

Ezzine-de-Blas, D., Corbera, E., Lapeyre, R., 2019. Payments for Environmental Services and Motivation Crowding: Towards a Conceptual Framework. Ecological Economics 156, 434-443.

FA Wind, 2020. Umfrage zur Akzeptanz der Windenergie an Land – Herbst 2020, Berlin.

Frey, B.S., 1997. Not Just for the Money: An Economic Theory of Personal Motivation. Elgar, Cheltenham.

García, J.H., Cherry, T.L., Kallbekken, S., Torvanger, A., 2016. Willingness to accept local wind energy development: Does the compensation mechanism matter? Energy Policy 99, 165-173.

George, D., Mallery, P., 2002. SPSS for Windows Step by Step: A Simple Guide and Reference, 11.0 Update, fourth ed. Allyn and Bacon.

Gross, C., 2007. Community perspectives of wind energy in Australia: The application of a justice and community fairness framework to increase social acceptance. Energy Policy 35, 2727-2736.

Hille, S., Weber, S., Brosch, T., 2019. Consumers' preferences for electricity-saving programs: Evidence from a choice-based conjoint study. Journal of Cleaner Production 220, 800-815.

Huber, J., Train, K., 2001. Marketing Letters 12, 259-269.

Hyland, M., Bertsch, V., 2018. The Role of Community Involvement Mechanisms in Reducing Resistance to Energy Infrastructure Development. Ecological Economics 146, 447-474.

IPCC, 2018. Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in: Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (Ed.).

Kruskal, J.B., 1965. Analysis of Factorial Experiments by Estimating Monotone Transformations of the Data. Journal of the Royal Statistical Society: Series B (Methodological) 27, 251-263.

Kuehn, R.R., 2000. A Taxonomy of Environmental Justice. Environmental Law Reporter 30, 10681.

Lancaster, K.J., 1966. A New Approach to Consumer Theory. Journal of Political Economy 74, 132-157.

Leer Jørgensen, M., Anker, H.T., Lassen, J., 2020. Distributive fairness and local acceptance of wind turbines: The role of compensation schemes. Energy Policy 138.

Liebe, U., Bartczak, A., Meyerhoff, J., 2017. A turbine is not only a turbine: The role of social context and fairness characteristics for the local acceptance of wind power. Energy Policy 107, 300-308.

Lienhoop, N., 2018. Acceptance of wind energy and the role of financial and procedural participation: An investigation with focus groups and choice experiments. Energy Policy 118, 97-105.

Luce, R.D., Tukey, J.W., 1964. Simultaneous conjoint measurement: A new type of fundamental measurement. Journal of Mathematical Psychology 1, 1-27.

Macdonald, C., Glass, J., Creamer, E., 2017. What Is the Benefit of Community Benefits? Exploring Local Perceptions of the Provision of Community Benefits from a Commercial Wind Energy Project. Scottish Geographical Journal 133, 172-191.

Meyerhoff, J., Ohl, C., Hartje, V., 2010. Landscape externalities from onshore wind power. Energy Policy 38, 82-92.

Orme, B., Chrzan, K., 2017. Becoming an expert in conjoint analysis: Choice modeling for pros. Sawtooth Software, Orem, UT.

Rand, J., Hoen, B., 2017. Thirty years of North American wind energy acceptance research: What have we learned? Energy Res. Soc. Sci. 29, 135-148.

Regen, S.W., 2014. Community Benefits from Onshore Wind Developments: Best Practice Guidance for England. Department of Energy and Climate Change.

Rode, J., Gómez-Baggethun, E., Krause, T., 2015. Motivation crowding by economic incentives in conservation policy: A review of the empirical evidence. Ecological Economics 117, 270-282.

Rossi, P.E., Allenby, G.M., 2003. Bayesian Statistics and Marketing. Marketing Science 22, 304-328.

Salm, S., Hille, S.L., Wüstenhagen, R., 2016. What are retail investors' risk-return preferences towards renewable energy projects? A choice experiment in Germany. Energy Policy 97, 310-320.

Sawtooth Software, 2017. The CBC System for Choice-Based Conjoint Analysis, in: Sawtooth Software, I. (Ed.), Technical paper series, 9 ed, Orem, Utah.

Sawtooth Software, I., 2009. The CBC/HB System for Hierarchical Bayes Estimation Version 5.0, in: Sawtooth Software, I. (Ed.), Technical Paper, Sequim, WA.

Statistisches Bundesamt, 2020a. Bevölkerung: Deutschland, Stichtag.

Statistisches Bundesamt, 2020b. Bevölkerung: Deutschland, Stichtag, Altersjahre.

Statistisches Bundesamt, 2020c. Bevölkerung: Deutschland, Stichtag, Geschlecht.

Strazzera, E., Mura, M., Contu, D., 2012. Combining choice experiments with psychometric scales to assess the social acceptability of wind energy projects: A latent class approach. Energy Policy 48, 334-347.

Tabi, A., Hille, S.L., Wüstenhagen, R., 2014. What makes people seal the green power deal? — Customer segmentation based on choice experiment in Germany. Ecological Economics 107, 206-215.

Titmuss, R.M., 1970. The gift relationship: from human blood to social policy. Allen & Unwin, London.

Toke, D., Breukers, S., Wolsink, M., 2008. Wind power deployment outcomes: How can we account for the differences? Renewable and Sustainable Energy Reviews 12, 1129-1147.

Vuichard, P., Stauch, A., Dällenbach, N., 2019. Individual or collective? Community investment, local taxes, and the social acceptance of wind energy in Switzerland. Energy Res. Soc. Sci. 58.

Walker, B.J.A., Wiersma, B., Bailey, E., 2014. Community benefits, framing and the social acceptance of offshore wind farms: An experimental study in England. Energy Res. Soc. Sci. 3, 46-54.

Walter, G., 2014. Determining the local acceptance of wind energy projects in Switzerland: The importance of general attitudes and project characteristics. Energy Res. Soc. Sci. 4, 78-88.

Wolsink, M., 2000. Wind power and the NIMBY-myth: institutional capacity and the limited significance of public support. Renewable Energy 21, 49-64.

Wüstenhagen, R., Wolsink, M., Bürer, M.J., 2007. Social acceptance of renewable energy innovation: An introduction to the concept. Energy Policy 35, 2683-2691.

Paper II

Crowdsourcing social acceptance: Why, when and how project developers offer citizens to co-invest in wind power[7]

Jakob Knauf[8][9] and Rolf Wüstenhagen[9]

Abstract

Citizen co-investment in wind energy projects has recently received a lot of attention among scholars and policymakers as a way to finance renewable energy projects and increase community acceptance of these projects. Citizen co-investment refers to the process by which members of the local community can financially participate in renewable energy projects prior to or shortly after construction. While previous research has often been cross-sectional and focused on the preferences of citizen-investors, this paper focuses on the perspective of project developers and asks why, when and how they offer citizens the opportunity to co-invest in wind farms. The work is based on the analysis of fourteen in-depth interviews with a sample of experienced German wind energy developers. The analysis shows that the decision to offer co-investment is driven by citizen demand and local stakeholder preferences, rather than financial needs. We shed light on how experienced developers deal with key trade-offs in terms of the timing of their offering and the choice of capital structure. As a result, we offer a number of testable propositions for further research on the nuanced relationship between citizen co-investment and social acceptance and derive recommendations for policymakers.

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Keywords: wind energy, co-investment, community acceptance, crowdfunding, debt, equity

1. Introduction

Thanks to economies of scale and technological learning, wind energy is now one of the cheapest sources of electricity (Lazard, 2021). Due to its large resource potential and low cost, further expansion of wind power generation plays a central role in many national climate plans. Seven European countries already get more than 20% of their electricity from wind power, led by Denmark with a share of 48% (Wind Europe, 2021). The wind industry has undergone significant professionalization in recent years. In the early days, it was driven by the passion of individual farmers or grassroots initiatives who put up a few wind turbines. By now, multinational utilities are building large wind farms, and smaller, specialized developers are often working on an entire portfolio, allowing them to diversify the risk and redeploy their skills after selling completed projects to larger investors.

The trend towards professionalization and economies of scale has helped to improve the commercial viability of wind power, but it comes with its own challenges. Unless the communication process between project developers and local residents is properly managed, there is a risk that the greater distance between communities and wind power investors results in social acceptance challenges. However, even proper communication is not a guarantee for acceptance. Also, the increasingly competitive environment created by auctions and other policy schemes aimed at minimizing cost may decrease the diversity of actors (Côté et al., 2022), as citizen-led initiatives, such as wind farms owned and operated by community members, are being crowded out of the market (Weiler, 2021).

One suggestion to address the social acceptance challenges is to improve distributional justice by sharing the financial benefits with the local community. Some project developers voluntarily offer citizens the opportunity to invest in their projects, while others have set up community benefit schemes, which involve payments to the municipality or directly to citizens of the host community. Several governments in Europe have recently moved towards introducing regulatory frameworks for such schemes, or even making them mandatory. In contrast to community benefit schemes, co-investment implies that citizens do not only share the benefits, but it also requires them to put their own money at risk. A variety of financial instruments are being used for citizen co-investment, including equity- and debt-based models.

While the intuition that a fair distribution of risks and benefits improves acceptance is quite compelling, there are two important shortcomings in the prior literature linking citizen co-investment to social acceptance. First, much of the research is cross-sectional in nature, therefore failing to capture the dynamic processes of social acceptance. In our work, we address the period between the start of planning and the commissioning of the wind farm and explore why, when and how project developers use financial participation during this period. Second, while several scholars have investigated co-investment from the perspective of citizens and their willingness to invest (Yildiz, 2014; Goedkoop and Devine-Wright, 2016; Ebers Broughel and Hampl, 2018; Lienhoop, 2018; Linnerud et al., 2019; Vuichard et al., 2019), less attention has been paid to the perspective of the project developers and their design choices, or their decision to offer such schemes in the first place.

The present paper addresses both gaps by asking the following question: "Why, when and how do project developers offer citizens the opportunity to co-invest in wind power?" To answer our research question, we conducted fourteen qualitative interviews with a set of experienced project developers active in the German wind energy market. The rich industry experience of our interview partners allows us to come up with a nuanced conceptual framework of the role that co-investment play at key points in the project development process. Our findings suggest that improving social acceptance, rather than merely tapping into an additional source of financing, is the main driver for offering citizens to co-invest. They also illustrate how experienced developers deal with key trade-offs when designing such schemes, including the trade-off between allowing early participation and offering a secure investment, and the trade-off between pursuing an inclusive approach and keeping complexity manageable, and hence ensuring financial viability of the project. Finally, our results show that experienced developers are critically aware of the dynamics of community acceptance not just within a given project, but also with regard to their ability to implement future projects in the same region.

The paper proceeds as follows. Section 2 reviews the literature on wind energy project development, citizen co-investment and its influence on social acceptance. Section 3 introduces our methodological approach, Section 4 presents the results of our interviews and Section 5 concludes the paper by discussing the main findings, presenting an advanced conceptual framework, and deriving policy recommendations and opportunities for further research.

2. Literature review

2.1. Financing wind energy project development

As a mature technology, wind energy is attracting large amounts of investment worldwide. $138.2bn were invested globally in 2019 (UNEP Centre/BNEF, 2020), representing about half of all global renewable energy investment combined. With a share of almost 80%, onshore wind continues to attract the largest amounts of capital. A large part of this is energy companies and institutional investors acquiring turnkey projects when they have been built (Bergek et al., 2013; IRENA, 2020). Long before such investments can be made, however, a particular type of player is laying the foundation for further growth of wind energy: project developers. Figure 1 offers a stylized representation of the process of developing a wind project (Broughel and Wüstenhagen, 2022). The first stage is about identifying an appropriate site with conducive conditions, first and foremost sufficient wind speeds, but also access to the electricity grid and the infrastructure needed for construction and maintenance. This is then followed by securing land rights and taking wind measurements and other necessary assessments. The next stage is the permitting process, usually involving an environmental impact assessment. If and when all the necessary permits have been obtained, the actual construction of the project can start, followed by the operation phase, during which the project generates electricity and thereby revenues. At the end of the operation phase, the project is either decommissioned or replaced with new turbines (repowering). Throughout this process, the risk tends to decrease, while the value of the project tends to increase. In the very early stages, there is a high probability of failure, so similar to venture capitalists, the players investing here have developed specialized capabilities to cope with high levels of risk and uncertainty (Lam and Law, 2016).

One of the prominent risks in developing wind projects is social acceptance, and in particular community acceptance (Wüstenhagen et al., 2007). Especially when it comes to securing land rights and permits, local stakeholders can make or break a project (Enevoldsen and Sovacool, 2016). Therefore, successful project developers place particular emphasis on how to manage this risk and keep salient stakeholders satisfied throughout the entire process. The literature suggests that procedural justice, distributional justice and trust are three key factors to enhance community acceptance (Schlosberg, 2007; Goedkoop and Devine-Wright, 2016). Offering local citizens to co-invest in the project is widely seen as a promising way to address all three of those

factors, and in particular distributional justice. Rather than just having to live with the impacts of a project (such as landscape change), citizens who are given the opportunity to co-invest can also get their fair share of the project's benefits, thus improving distributional justice (Warren et al., 2005; Musall and Kuik, 2011; Walker and Baxter, 2017; Leer Jørgensen et al., 2020).

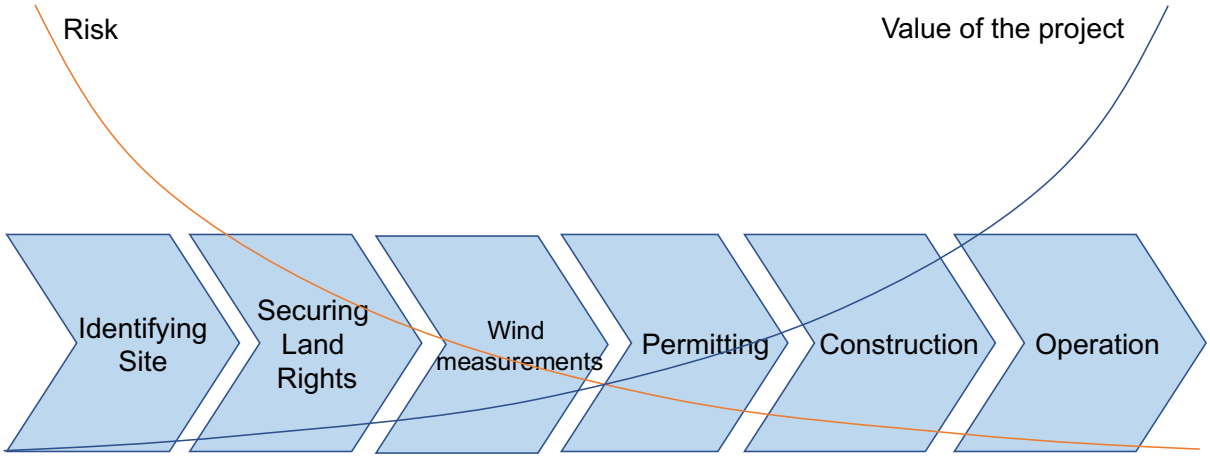

Figure 1: Stages of the project development process (adapted from Broughel and Wüstenhagen (2022))

Once a project has successfully made it to completion, there is often a change in ownership (or "exit"), comparable to a trade sale in venture capital (Rin et al., 2013), allowing an independent developer to sell their stake, realize profits, and redeploy capital to their next early-stage investment. Successful developers will take this exit into account in the decisions they make in previous stages of development, including the decision whether and under which conditions to invite citizens to co-invest.

2.2. Citizen co-investment, crowdfunding and crowdsourcing

Financing early-stage projects used to be the domain of specialized investors such as venture capitalists (Mollick, 2014; Mazzucato and Semieniuk, 2018). In recent years, enhanced by developments in information technology, crowdfunding has become an additional funding channel for risky entrepreneurial projects. Crowdfunding refers to an informal financing mechanism, whereby projects are briefly described on an online platform and investors can then decide which projects to find. In contrast to crowdfunding, where an investee seeks financial resources from a large number of outside players ("the crowd"), the term crowdsourcing refers to seeking non-financial resources, such as ideas, from the crowd (Allon and Babich, 2020). A range of different projects, from non-profit to for-profit and anything in between, participate in crowdfunding, and different platforms have specialized in catering to investors with

a particular risk-return profile. On the for-profit side of the spectrum, crowdfunding platforms offer opportunities to invest in either debt or equity (Paschen, 2017).

When it comes to wind power projects, the idea of getting the "crowd" on board is reflected in citizen co-investment schemes. These are on one hand driven by the same trends as crowdfunding in other areas – the opportunities created by online platforms, investees' desire to identify new and uncomplicated funding channels – but are also part of a broader trend towards "democratizing" the energy system by allowing local actors to financially participate in shaping tomorrow's energy system, rather than leaving those decisions up to a small number of corporate decision makers or anonymous participants in financial markets (Szulecki, 2017; Solman et al., 2021). Similar to crowdfunding in general, citizen co-investment is offered with a variety of financial and non-financial motivations (Salm et al., 2016; Curtin et al., 2019).

One of the promises of both crowdfunding and citizen co-investment is that it circumvents the inconveniences of financial market regulation and offers an unbureaucratic way for entrepreneurs to tap into new sources of capital (Rossi, 2014). This, however, might be a transient phenomenon, as crowdfunding has repeatedly been criticized for representing an unprofessional investment environment, giving uninformed retail investors access to high-risk investments that they poorly understand. Similarly, high-profile failures tend to lead to calls for more stringent regulation, as it was the case in Germany after the collapse of Prokon Wind, a financial service provider specializing in raising funds from retail investors for wind power projects.[10]

2.3. Financial participation and social acceptance

From the point of view of a project developer, allowing citizens to financially participate in wind projects has a dual appeal: It represents an additional source of financing, and it is supposed to have positive spillover effects on social acceptance. As mentioned above financial participation can come in different forms. Citizens can either become co-owners of a wind farm by investing in equity, or they can become lenders to the project by investing in debt (see Figure 2) (Beery and Day, 2015). The most common form of equity investment in Germany is the limited partnership, which gives equity investors full voting rights (Holstenkamp, 2014). In terms of debt

[10] Holtermann, F., Iwersen, S., Nagel, L.-M., Verfürden M. (2021): "Im grün-grauen Sumpf" ["In the green-grey swamp"]. Handelsblatt, September 17, 2021, pp. 44-50.

investment, subordinated loans allow developers to raise up to 6 million Euros per project with a maximum of 25,000 Euros per person. The corporate finance literature would suggest that developers prefer issuing debt because it lowers the cost of capital and allows them to retain full ownership (Graham and Harvey, 2001). However, in the early, high-risk stages of a project, debt may not be readily available.

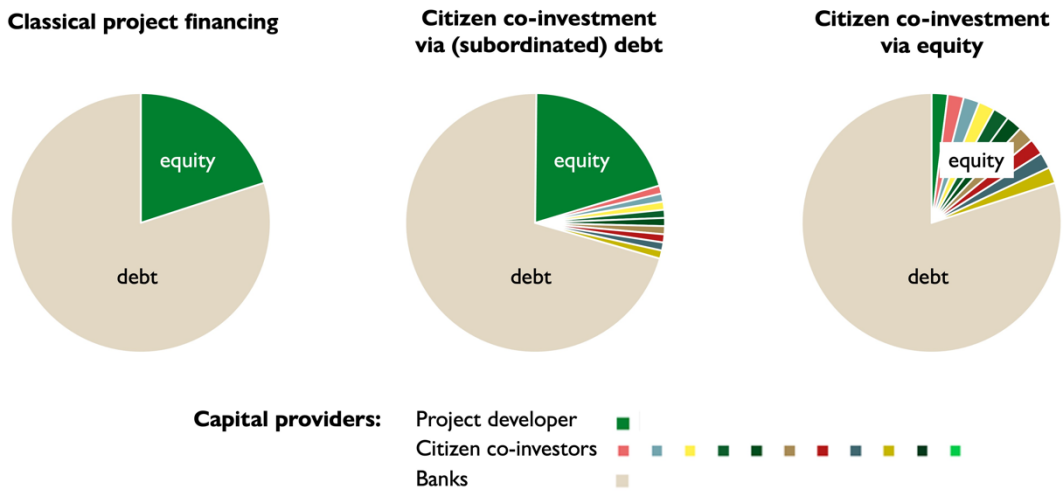

Figure 2: Types of co-investments considered in this study (Note that the size of each segment varies from project to project).

A third option are community benefit schemes that allow citizens (e.g., through their local municipality or an independent fund) to participate without investing (Cowell et al., 2011; Strachan et al., 2015; Kerr et al., 2017). All these options appear to be related to an increase in distributional justice compared to a situation where there is no financial participation (Beery and Day, 2015; Lienhoop, 2018). Vuichard et al. (2019) have investigated which of the three options is most effective at increasing acceptance among citizens in Switzerland and found somewhat inconclusive effects. Their results show a small but not significant effect of community benefit schemes on social acceptance compared to a scenario where there is no financial participation. As for co-investing in a wind farm via equity or debt, they find a slight preference for equity. Distinguishing between different investor segments, it becomes evident that some forms of financial participation can even decrease social acceptance, whereas it is most effective in increasing acceptance among citizens with a progressive-centrist political orientation. These findings offer an interesting starting point for our investigation. We build on prior research by adding the project developers' perspective and hope to shed more light on some of the nuances and moderating factors through a qualitative approach.

3. Data and Methods

This study is based on fourteen semi-structured interviews with German wind energy project developers who had experience in designing financial participation models. While the sample included a range of different developers, our focus on experienced developers excluded organizations on the pure grassroots end of the spectrum. We consider both professional and citizen energy organizations as independent developers.

The interviewees all had more than 2 years of experience with project development and stakeholder management. Some had more than 20 years of experience. We studied developers and utilities of various sizes, from sole proprietors to international corporations. Some companies operate only locally, others all over Germany, across Europe or even worldwide. Whether small citizen energy associations or large corporations, all companies are subject to the same approval mechanisms. Financial citizen participation in the form of co-investments was not required by federal or state laws at the time of the interviews.

Germany was chosen as the empirical focus of the study because it represents one of the largest European onshore wind markets. The German case is also of interest because new installations had been slowing down in recent years, which was largely attributed to social acceptance issues (Stede et al., 2021; Ruddat, 2022). The country has a long tradition of community and cooperative ownership in the energy sector, and both federal and state-level governments have recently started experimenting with regulation aimed at increasing social acceptance via local financial participation.

Interviews were conducted between April and July 2021 by phone or videoconference and were recorded, fully transcribed, and analyzed. All respondents consented to the recording under conditions of confidentiality. Anonymized information about the sample can be found in Figure A.1 (Appendix I).

The interview guideline (Appendix II) started with open-ended questions about the background of the project developer and their views on wind energy in Germany, followed by a set of questions about participation in general, and financial participation in particular, especially co-investment models. Interviewees were invited to talk about their most successful and unsuccessful projects, and the reasons for success or failure from their perspective. To ensure that all the topics that the interviewees considered important were covered, the interviews were ended by asking if there was anything else they would like to say that had not yet been addressed.

Based on the insights from the initial interviews and in light of the experience level of respondents, it turned out to be effective to let interviewees talk relatively freely about their projects, and only revert to the survey instrument in case important aspects were left untouched.

All interviewees had designed at least one co-investment model for an existing wind farm or a project that is currently under development. The sample consists of developers with experience in different locations across Germany and a variety of organizational backgrounds. The initial contacts resulted from a secondment of one of the co-authors with one of the leading consulting firms for citizen co-investment models in Germany, which helped to establish introductions to a set of high-quality interviewees with significant experience in the field. through referrals and contact information on crowdfunding platforms and project websites. Of the fourteen interviews, six were referred through business relationships. Two others were recommended by interviewees, but there was no business relationship between them. The remaining six interviewees were found through crowdfunding platforms and extensive online searches.

While our qualitative research approach was not aiming at a representative sample per se, how do our interviewees compare to the overall population of German project developers? Given the broad spectrum of players and the changing nature of this industry, it is difficult to determine the exact size and structure of the target population. The Fachagentur Windenergie an Land (FA Wind[11]), a public-private partnership involving government agencies at federal and state level, firms, industry associations and environmental NGOs to support the development of onshore wind in Germany, lists 16 major corporate members from the energy industry, all of whom are active in wind energy project development. A major German renewable energy industry portal[12] lists the names of 15 developers, eight of which overlap with the FA Wind membership directory. Based on these numbers, we assume that there are about 20 to 25 major project developers in the German market. In line with Deutsche WindGuard (2015), we expect those 20 to 25 major developers to account for about two thirds of all installed capacity in Germany. The remaining third of the market is very diverse and involves a large number of small and medium-sized players, often only

[11] https://www.fachagentur-windenergie.de/ueber-uns/mitglieder/
[12] https://www.windbranche.de/firmen/info-298-projektierer

active on a local scale. We estimate that several hundred players have developed onshore wind projects in the different German regions in the past, but many of them are no longer active today. Our sample reflects this diversity of the population of project developers by including respondents working for a balanced mix of small, medium-sized and large organizations, and by including both electric utilities as well as independent project developers (including citizen energy organizations).

The transcribed interviews were analyzed according to the bottom-up thematic analysis as described by Braun and Clarke (2006). The first step of the method includes listening, transcribing, and reading the interviews. Based on this, the second step involved the researcher creating the initial codes. The codes are based on the findings that emerged after the initial engagement with the data. This engagement with the data resulted in a long list of codes, which were combined into themes in a third step. In a fourth step, the themes were revised. This involved re-coding the interviews once again. It was checked if the results fit the themes or if they had to be adjusted again. After some iterative steps, the themes presented in the following section emerged as to why project initiators offer co-investment. The final step of the analysis is reporting of the results.

4. Results

This section will report on the main findings along four main clusters that emerged from the expert interviews. Each of the following sections will address one of the following sub-questions:

1. Why do project developers offer citizen co-investment?
2. When do project developers offer citizen co-investment?
3. To whom do project developers offer citizen co-investment?
4. Which type of citizen co-investment do project developers offer?

Taken together, the insights gathered with regard to those sub-questions will allow us to answer the overall research question of the paper. To strike the right balance between conveying the rich nuances emerging from the interviews and capturing the main findings in a condensed form, we will on one hand present specific interview quotes supporting the argument in each subsection, and on the other hand end each subsection with testable propositions for further research. At the end of this section, we will present a revised model of the project development process to visualize the main findings.

4.1. Why do project developers offer citizen co-investment?

At first glance, it may seem obvious why a project developer would invite new investors: financing a wind farm requires substantial amounts of capital, and the more sources of funding the developer can tap into, the better. But is financing really the bottleneck for onshore wind projects in Germany? Evidence from great number of our interviews suggests that this is not necessarily the case. Several developers pointed out that the demand for wind power investment opportunities tends to exceed supply, as this statement illustrates:

"[For citizen investors,] it's highly interesting. It's going to be ripped out of your hands. (…). So there's no need to worry about that." (Interview 8)

One interviewee mentioned an experience with offering citizen the opportunity to co-invest in a specific project saying "we needed four million Euros for this wind park. (…). People offered 14.5 million Euros. That is more than three and a half times." (Interview 2)

In addition to the strong demand from citizens expressed by these respondents, there are also other funding sources. Several developers mentioned that bank financing has become much easier in the maturing German wind market. So how, then, do developers decide which funding sources they prefer, and what is the rationale for using citizen co-investment? Some of the literature would suggest that funding from citizens would offer a low-cost source of capital, and thereby allow project developers to reduce financing cost (Salm et al., 2016). The developers in our sample, however, regardless of whether independent developer or utility company, seemed to disagree, especially in light of the current low-interest rate environment as the following quote suggests:

"Of course we could have refinanced ourselves much more cheaply [if we] raised funds on the market than through citizen participation. (…). So I think these are quite expensive projects, the citizen co-investment projects. Because, as I said, the interest rate is 1 to 1.5 percent higher than how you can refinance on the capital market." (Interview 3)

Proposition 1: When it comes to financing German onshore wind projects, supply of capital exceeds demand. Therefore, project developers do not rely on citizen co-investment as a source of financing.

Proposition 2: Offering citizen co-investment opportunities increases, rather than decreases, a wind project's cost of capital.

If there is no shortage of other sources of capital, and if the cost of acquiring citizen co-investment is indeed higher than tapping into alternative sources of capital, there must be other reasons that lead project developers to consider co-investment offerings. An important driver that has repeatedly been mentioned by all types of developers is the link to social acceptance, as this statement illustrates:

"How do you involve the communities, the residents there? And how do you get more acceptance for follow-up projects? And that's actually the main reason of why we've been offering citizen participation in the last two years, in terms of frequency, amount and conditions." (Interview 14)

Interviewees seem to have a common understanding that citizens eligible for investment should preferably live near the turbines. Sometimes developers specify a radius of a few kilometers within which citizen investors must live, while in other cases citizens in surrounding zip codes of a planned wind farm site are eligible for investment. As several interviewees mentioned, the aim of increasing social acceptance relates to current projects. However, it also aims at enabling future projects. Whether or not citizen co-investment is linked to social acceptance depends on when, to whom and how project developers offer financial participation. This is going to be further discussed in the next subsections.

4.2. When do project developers offer citizen co-investment?

When introducing the project development cycle shown in Figure 1 above, we pointed out that two stages can be identified where local stakeholders can either make or break a wind project: securing land rights and permitting. Our interviews show that experienced project developers are mindful of the time dimension of social acceptance and try to take this into account as they design citizen co-investment offers tailored to critical milestones.

"It is all about timing, at what point of time do you launch such a project?" (Interview 1)

When it comes to securing land rights, our interviewees stated that the municipality is often asking for financial participation as a prerequisite for a land lease.

"But it also always depends on who you are talking to. Is it the municipality that is now saying we would like to have public participation? Is it the municipality that is even the grantor? And that makes this a prerequisite, so to speak, for signing an agreement in the first place: A binding promise of some kind of public participation.

This means that a developer is, quote unquote, 'forced' to hold out the prospect of such an offer." (Interview 7)

Interviewee 8 shared the experience that offering the prospect of financial participation improves the chances of securing a site:

"This is a very, very competitive market. And first and foremost, it is important to secure sites. In other words, it is important to stake your claims. And depending on the project, the issue of direct or indirect participation can play a role [in securing a site]."

The other stage where financial participation can be crucial is further downstream in the project development process, when it comes to the time before officially applying for the permit. According to the interviewees, local authorities will take public opinion into account when making such decisions, and a larger number of beneficiaries may lead to more favorable sentiment in the community than if it was only a few landowners who financially participate. While unlike in other countries (e.g., Switzerland), it is the exception rather than the rule to have a popular vote about a project, local politicians will take their voters' opinion into account as they take decisions related to the project. This can also be leveraged by opponents. One interviewee pointed out how vocal opposition had an influence on the permitting process:

"The council wanted to decide that the land use plan would be changed accordingly, as we had previously discussed for many years. And one week before this council meeting, a citizens' initiative against wind energy appeared (...) who did good a good job with public relations and has worked with fear. This unsettled the council so much that it said, no, let's not do this right now." (Interview 1)

Given that offering citizens the opportunity to co-invest could have positive effects on social acceptance at both an early stage (around securing land rights) and a later stage (shortly before the permitting phase), but that this offer can only be made once, the question arises what the perfect timing of such offers is. This turns out to be a non-trivial trade-off that many interviewees mentioned. One respondent summed it up as follows:

"It is very, very difficult to catch the right moment. Because when you think about it, you first have to talk to the landowners to see if you can do something with the land. Conclude lease agreements with them. (…). That is, the moment you talk to people, things start to get public. Because they tell their neighbors or someone else. And then

those say: 'What? Someone wants to build a wind turbine! What can you do and I've never heard anything about it.' And that's a point in time when you can't really say anything for sure. Because first of all, you don't know if the person will sign. Then you have maybe five or six owners, of whom you also don't know whether they will sign. And then rumors start. And you have to try to communicate as much as possible. And yet uncertainties arise, because you can't say at all what the project will look like. And that is a very, very sensitive point. To say when I can really start communicating. When can I reaching out to the population? And it's often the case that the mayors, the landowners or, in some cases, the people who are out and about, they underestimate this. And when rumors start flying around, it's difficult to get them back." (Interview 6)

On one hand, to avoid rumors and negative word-of-mouth, it would be desirable to offer financial participation as early as possible. But on the other hand, as Interviewee 6 pointed out, there is a trade-off between communicating (and ultimately co-investing) at an early stage and being able to offer reliable information and a secure investment. This is confirmed by another interviewee, reporting on the experience with one of their projects:

"[In the early stages of the project] of course the risk is insane, at what point do I go in? I have a project now. It's almost finished. We're probably going to somehow apply for a permit, and hopefully get one. And maybe build next year. But we needed to pre-finance much earlier, so we wrote an incorporation agreement, founded a company. And at that time, all the citizens, all the neighbors had to sign how much money they would put into it. And I went in very conservatively, because I was aware of how high the risk was that this project would not be implemented at all. So I'm almost surprised that so many people have actually put a large sum of money into it. (…). Now they are lucky that it actually works out." (Interview 1)

Apart from hoping for the best and "being lucky", one factor that can mitigate this trade-off between launching a citizen co-investment opportunity early vs. later in the process, some developers address the issue with a staged communication approach. By making a general announcement about their intention to offer financial participation early in the process, they set the expectation that the locals will be able to co-invest. By making the actual specific investment offer at a later stage, they take advantage of the fact that some of the initial uncertainties will be resolved before citizens will actually have to put their money on the table. This is how one project developer describes this time lag:

"As a project developer, we also offer citizen participation with the aim to get the local people on board. And that's why it should actually be done very, very early in the project development. On the other hand, you can't. Because if you want to offer a really secure [financial] product, you actually need all the specific values, such as the remuneration you will get under the EEG [Renewable Energy Act]. (…). There is a gap of three to five years between when we actually want to offer it, namely at the moment when we are on site, when we talk to the community. Where we say, okay, we are actually prepared to offer citizen participation. And the moment when you can actually put everything on the table that an investor, a private investor, would like to see." (Interview 7)

The time lag in the development process can be used as a way to balance both objectives, but there may be limits to this approach. The interviewees stated that waiting for too long with making a specific offer could have a negative impact on the momentum in the local community and hamper the credibility of the developer.

We summarize the main interview findings with regard to when project developers offer citizen co-investment opportunities with the following propositions.

Proposition 3: Announcing citizen co-investment as early as possible increases its impact on social acceptance.

Proposition 4: Making a specific citizen co-investment offering and collecting money too early increases risk that the project developer cannot keep the promise or that investors lose their money.

Proposition 5: Successful project developers use a staged communication approach, where they make a general announcement early in the process, followed by a more specific offering at a later stage.

4.3. To whom do project developers offer citizen co-investment?

Apart from the timing of the offering, another interesting trade-off surfaces when reflecting about to whom the co-investment opportunity should be offered. From the point of view of maximizing the impact on social acceptance, it seems desirable to take as many people as possible on board as co-investors, and that appears to be the strategy of some project developers:

"We had capped the participation at 5'000 [Euros per person]. In terms of volume, it would have been possible to raise considerably more money if we had allowed larger amounts per capita. Because that would certainly have been appealing to some people.

But that wasn't the goal in the first place: to raise as much money as possible. It was to reach as many people as possible." (Interview 11)

Such an inclusive strategy, however, has two drawbacks, as a large number of interviewees stated. First, as mentioned above, especially in the early stages of developing a project, the risk is quite high, and perhaps too high for the average retail investor. Second, every new investor that is taken on board tends to increase transaction cost. Making decisions with a small number of investors is a lot easier than doing the same if a project has hundreds of citizen co-owners. This becomes particularly relevant when the developer wants to add new shareholders or exit the investment at the end of the project cycle, as this statement illustrates:

"Let's put it this way, an [institutional] investor naturally has no great interest in having any micropartners in such a financial structure." (Interview 8)

Some developers, especially those who categorize themselves as citizen energy organizations, said that they do not want to exit and therefore hundreds of citizen co-owners are not an issue for this reason. However, they pointed out some challenges, such as that it is almost impossible to add new citizen investors later.

The following two propositions summarize our main findings with regard to how project developers decide to whom they offer an opportunity to co-invest:

Proposition 6: Offering co-investment opportunities to as many local citizens as possible increases its impact on social acceptance.

Proposition 7: Citizen co-investment has to be traded off against the desire to have a clean capital structure at the time the project developer wants to exit.

4.4. Which type of citizen co-investment do project developers offer?

Picking up on the somewhat inconclusive findings of Vuichard et al. (2019) about citizen preferences for various forms of financial participation, how do project developers decide which of the financing instruments sketched out in section 2.3 to apply? Which form of financial participation do they prefer, and what do they think best fits their dual objectives of finding social acceptance for a project and earning a decent return? Based on our interview findings and what we have laid out in the previous sections, we propose that a key to resolving the apparent incoherence in prior literature is to take the dynamic nature of the project development process into account. There is no one size-fits-all approach to determine an ideal co-investment

model, but the offering can be tailored to where a specific project is located, both in the development cycle and geographically.

Before thinking about which instrument to choose, it is important to take into account the preferences of both parties, the developer and the prospective citizen investors, in terms of who should hold the decision-making authority. One developer describes his considerations as follows:

"I think a lot of it comes down to the amount of funding you want to raise. But also, to what extent you want to involve investors in decision-making. Or how little you want to involve them. (...). That's the most important question you should ask yourself at the beginning when choosing a form of investment." (Interview 11)

While some of the social acceptance literature seems to suggest that giving more decision power to the locals is always better, our interviewees had some doubts whether this is actually what all citizen investors want:

"I don't know if people really want to have a say. You know, if I participate as a shareholder, maybe I don't want to participate in the company at all. I just want to invest money." (Interview 3)

Comparing the possibility to invest via equity or debt, our interviewees seemed to agree that in general, there is a larger number of investors who are interested in the lower-risk profile that is typically associated with debt, while the higher risk profile of investing in equity is (and should be) offered to a more restricted set of investors:

"So it depends on what your target audience is. If, of course, you only want to work with, let's say, semi-professionals, professionals, [issuing equity] is an option. But if the goal is to get local residents on board, there is no point inviting people to participate as shareholders." (Interview 3)

In the German context, subordinated loans appear to have become the preferred instrument for citizen co-investment in wind energy by many developers. According to them, as a form of debt, subordinated loans offer a relatively low risk profile (compared to equity), although some of our interviewees pointed out that the lender still faces the risk of a total loss. One thing that makes citizen co-investment via debt more attractive to both parties involved is the lower complexity of the transaction, or, as one interviewee put it:

"You also have to be able to understand it as a non-financial person, as an ordinary human being." (Interview 3)

However, as some interviewees pointed out, the preference for financial participation models may be different for experienced citizen investors, e.g., farmers, who are more used to taking entrepreneurial risk and making professional investment decisions. Therefore, as our interviewees pointed out, farmers have been frequent investors in wind energy projects in some parts of Germany, especially in the North and West where the sector has the longest history:

"The North has grown up with it. Every farmer has put up a wind turbine. 10 or 20 farmers have joined forces, they know it, they have made money [with wind energy] in the last 20 years." (Interview 7)

"Even as a small farmer, you get used to those sums. Already with the small turbines, the cost was around 300'000 Euros. And they knew that if everything goes wrong, a [farmer's] company can go bust." (Interview 5)

Given their long-standing experience with wind investments and their embeddedness in rural communities, farmers can also be very effective ambassadors to convince other co-investors:

"Nothing compares to when some veteran farmer, who already started with wind power 20, 30 years ago, stands up [in a meeting] and says for two and a half minutes: 'You know what guys, I've done this before, that's gonna work.'" (Interview 1)

While meeting the preferences of their target audience, the challenge of keeping transaction cost low is another factor that according to the interviewees determines how broadly a project developer invites citizen co-investment.

Issuing equity, on the other hand, tends to be subject to stricter regulation by financial market authorities as many interviewees stated, which basically results in the developer (and their lawyers) having to prepare a detailed prospectus, which can cost up to 100'000 Euros according to one interviewee. Complexity also increases because managing a larger number of equity investors comes with additional effort on the side of the developer, as this interviewee vividly points out:

"The disadvantage is really an enormous administrative effort if you have 300 limited partners per wind farm. (…). And then they also always bring different concerns and thoughts and worries. And not everybody always reads their letters the way they should, I'd say. So when you have to deal with a lot of people, then the probability increases that there are a few, well, annoying things in there from time to time." (Interview 13)

Contrary, there seems to be consensus among the interviewees that debt-based models have lower transaction cost compared to equity-based models. On the one hand, regulations are less strict, e.g., no prospectus is needed. On the other hand, debt-based models allow a higher degree of standardization of financial participation, e.g., through IT.

"In other words, these difficult financial market regulations, prospectus requirements and so on, already set the bar enormously high, so to speak, for people to be able to participate. And we are looking for ways and means to actually do that." (Interview 2)

"And that's why we have also developed these products in order to standardize them. Because it's a huge effort for us internally to look at each location and see whether they'd rather have a savings bond with the regional bank or whether they'd rather have this or that." (Interview 8)

Finally, we summarize that the choice of instrument depends on the timing of the offer. Equity-based models seem to work well in early stages, while including citizens at a later project stage seems easier with debt-based models. To conclude, as for the preferred type of financial instrument, we find that:

Proposition 8: Citizen co-investment via equity is more suitable to offer in the early stages of a project, while debt tends to be more suitable in the later stages.

Proposition 9: The higher risk implied by equity investments resonates more with (semi-) professional investors, whereas a majority of citizen investors prefer the lower risk profile of debt.

Proposition 10: Keeping transaction cost and complexity low is a key consideration when developers choose the most suitable financial instrument for citizen co-investment.

5. Conclusions and Policy Implications

5.1. Summary of main findings

Figure 3 summarizes the key findings from the interviews and allows us to answer the research questions based on a more nuanced view of the project development process and the relationship between citizen-co-investment and community acceptance. All findings are based on information provided by respondents and should be treated as such. We selected only those outcomes that were mentioned repeatedly by different interviewees.

Project developers considering offering citizens to co-invest in a wind energy project are faced with a trade-off: Making such an offer in the early stages of the project maximizes the opportunity for citizens to shape the project outcome and may thus be preferrable in terms of procedural justice. At the same time, the early stages of project development are characterized by high levels of risk, and the ability to offer a secure form of co-investment improves in later stages. We find that project developers address this trade-off in two ways: First, they distinguish between early-stage investment, offered to a smaller number of experienced and risk-taking investors, and later-stage investment, directed towards a broader, more risk-averse audience. Second, experienced project developers try to make productive use of the time lag between announcement and closing. They tend to announce their intentions to offer citizen co-investment opportunities early on, often in the context of securing land rights, and then wait with further specification until the project has gone through further de-risking. Ideally, this will also allow them to address citizens with a specific offering around the time of reaching crucial milestones like getting ready for the permitting process. We illustrate the developer's approach in Figure 3 by triangles (orange for equity and blue for debt). The blank triangle illustrates the approximate timing of the announcement (often without mentioning details). The light triangles represent the time when developers start to make specific offers, and the dark triangles show the time when the offers are closed, and citizens can no longer invest. As the bars at the bottom of the figure show, there is some flexibility here. In the very early stages, when risk is high (or "insane" as Interviewee 1 put it), equity may be the only option. In the later stages, both equity and debt are used for broader citizen investment, often with a preference for debt (or specifically subordinated loans) due to the higher security offered to small investors and lower transaction cost.

Many project developers' business models are specialized in the early stages of the process, ranging from site identification to construction, while they tend not to own operating assets. In these cases, any decisions they take about co-investors will be taken with their exit in mind. This can, for example, further increase the preference for debt over equity, as a clean capital structure makes it easier to find an acquirer in the transaction. Considerations about preparing for a successful exit, as well as about keeping capital cost low, are also driving the decision of many project developers to keep the share of equity ownership offered to citizens within certain limits (often up to 10 or 20%).

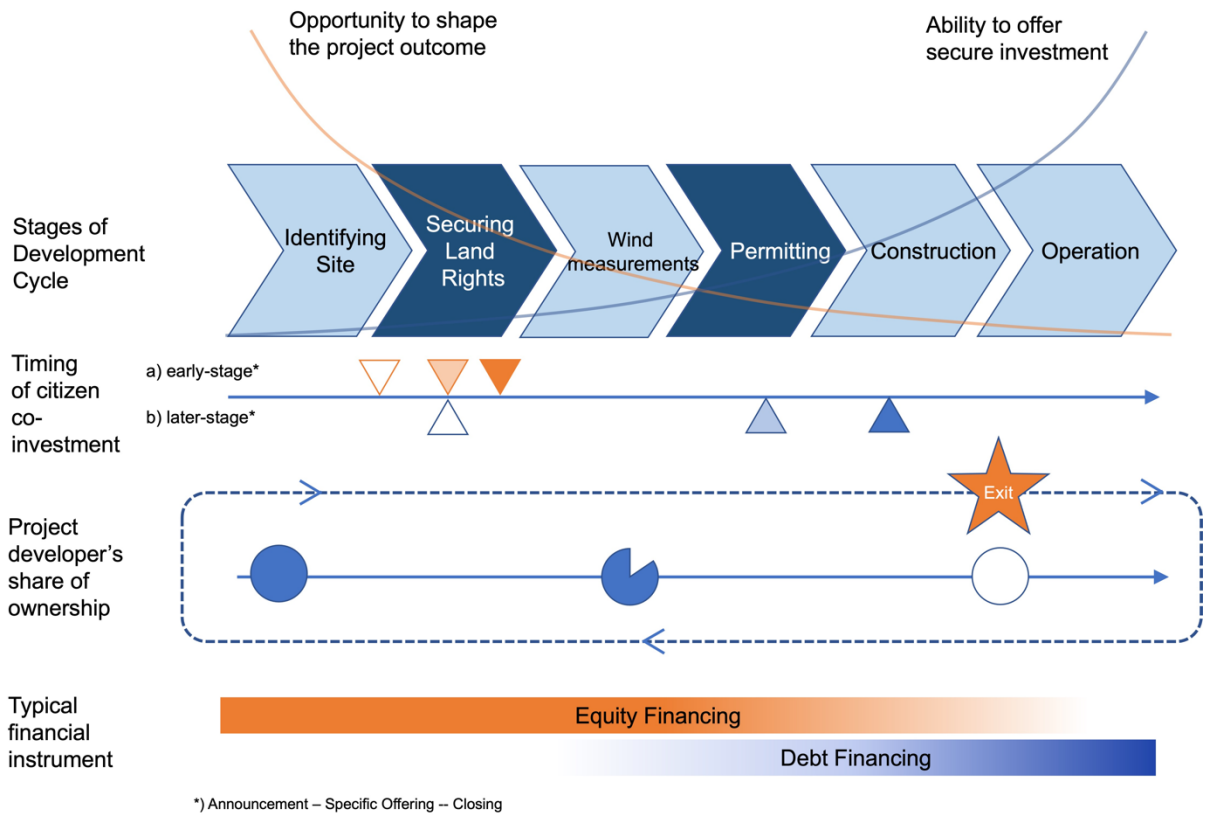

Figure 3: Advanced conceptual framework of citizen co-investment in the project development process.

5.2. Policy Implications

Our research findings suggest that incentivizing co-investment is done most effectively with a nuanced understanding of where and when along the project development cycle which type of citizen co-investment is most likely to be helpful. When it comes to the early stages, where risks are high, project developers tend to target a smaller set of risk-taking co-investors who are willing to provide equity with the understanding that there is a considerable probability of losses. These early-stage co-investments are on one hand desirable for anchoring a project in the local community early on, but they may also backfire if financial losses materialize[13]. They can be supported with tax incentives, but due to the trade-off between broad participation and the risk of financial losses, policymakers should apply caution when considering to promote early-stage co-investments to wider circles of citizens. Policy support that is particularly valuable to these kinds of investments would be anything that reduces the risk of further delays in the planning and permitting stages, and the

[13] cf. the high-profile failure of Prokon Wind mentioned above in Section 2.2

availability of sufficient land for new wind project development. As an example, the recent proposals by the German government and the EU Commission to further streamline permitting procedures are a step in the right direction.

Later-stage investments may be useful for supporting broader community acceptance by allowing a large number of citizens to financially participate in the project. The regulatory framework at this stage should reduce complexity and transaction cost. Given that projects have largely been de-risked at this late stage of the development process, there is less need to impose complicated measures and lengthy documentation aimed at protecting retail investors from the risks that are inherent in the early stages of new projects. As such, the trend towards ever tighter regulation of some segments of the financial market, which was perceived as increasing bureaucratic burden by some of our respondents, may be counterproductive. Tax incentives may have relatively less of an effect here, because the citizens involved tend to invest smaller amounts, but they may still be valuable as a signal that this is a credible investment category that offers reasonable risk-adjusted returns and contributes to an important societal goal, accelerating the low-carbon energy transition. What is also valuable for de-risking those later-stage investments is the prospect of not being fully exposed to electricity price volatility, so offering feed-in tariffs, contracts-for-differences, power purchase agreements or other forms of (partly) fixed compensation that hedges price risk can be a valuable indirect form of supporting citizen co-investment in renewables.

Policy measures aimed at increasing actor diversity may also be useful to promote citizen co-investment, in order to avoid crowding out local initiatives in, for example, competitive bidding processes. Lastly, an improved understanding of the dynamic nature of the project development process among local authorities and financial institutions, through training programmes and best practice case studies, would help to make developers more comfortable incurring the additional complexities of getting citizens involved in co-investing.

5.3. Limitations and further research

As any piece of research, our work is subject to some limitations that can be the starting point of further research. First, our research is based on a set of qualitative interviews with experienced project developers. While their longstanding experience was helpful in offering deep insights into their strategies and practices, we cannot exclude the possibility that some of their views are not representative of the whole population of

project developers. Future research could complement our analysis by talking to less experienced or unsuccessful developers, or those that have considered citizen co-investment but actively chosen not to pursue it. A larger, quantitative survey of project developers might also be insightful, provided that a large enough high-quality sample of professionals can be convinced to share their insights in such a format.

Second, for the sake of having a coherent sample, we chose to focus on one country, Germany, which has a long-standing history of wind energy development and citizen involvement in the energy transition. Future research could replicate our study in other wind energy markets, including those at different stages of development (e.g., the less mature Swiss market) or with different attitudes towards citizen involvement (e.g., US or China). While we believe that the general dynamics of the project development process should be quite constant across geographical regions, differences in the institutional framework may lead to different conclusions as to how best to incentivize citizen co-investment. These institutional influences may well extend beyond energy-specific issues and include taxation regimes and financial market regulation and preferred financial instruments. As early results from the implementation of community energy concepts across the European Union show, it is challenging to find one-size-fits-all approaches for citizen involvement that effectively work across different cultural settings.

Third, we focused our analysis on a particular form of financial participation, namely citizen co-investment. Some of our developers mentioned that they also have experience with community benefit schemes, where local communities or local citizens can financially benefit without having to put their own money at risk. Future research could systematically compare these two forms of financial participation, thereby also informing policymakers in countries (including, most recently, Germany) which have opted for legislation that regulates community benefit schemes. This would also allow finding out to what extent the two forms of participation are complementary, or whether one is crowding out the other.

Fourth, this paper reflects the perspective of project developers. Their perspective is important, but not the only one in the field, and successful policies will always have to strike a balance between the interests of a variety of stakeholders. This limitation concerns among others the policy recommendations, which would benefit from triangulation with other stakeholders, such as citizen investors. While we believe that high-risk co-investments should not be offered to inexperienced citizen investors, we do think that citizen involvement at an early stage is desirable and should be

encouraged. We recognize a need for research on how to manage the trade-off, possibly digging deeper into the contractual relationships used by successful project developers to govern the time lag between funding commitment and drawdown.

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Appendix

Table A.1: List of interviews.

Interview No.	Type of project developer	German Region	Number of employees	Wind power experience	Job Title	Date of Interview	Format	Duration	Educational Background
1	Independent project developer	West	< 20	> 5 years	Project Manager	24.04.2021	Phone Call	77 min.	Financial
2	Independent project developer	West	< 20	> 35 years	Managing Director	26.04.2021	Video Call	65 min.	Financial
3	Utility company	East	> 250	> 20 years	Project Manager	27.04.2021	Video Call	63 min.	Financial
4	Independent project developer	East	20 - 250	> 30 years	Member of the Board of Directors	12.05.2021	Video Call	53 min.	Non-Financial
5	Independent project developer	North	< 20	> 20 years	Entrepreneur	20.05.2021	Phone Call	72 min.	Non-Financial
6	Utility company	National	> 250	> 2 years	Senior Manager	21.05.2021	Video Call	64 min.	Non-Financial
7	Independent project developer	National	> 250	> 20 years	Senior Manager	25.05.2021	Video Call	69 min.	Non-Financial
8	Independent project developer	National	> 250	> 10 years	Division Manager	18.06.2021	Video Call	69 min.	Non-Financial
9	Independent project developer	North	< 20	> 20 years	Project Manager	07.07.2021	Video Call	63 min.	Non-Financial
10	Utility company/ Independent project developer	South	20 -250	> 10 years	Team Manager	08.07.2021	Video Call	77 min.	Financial
11	Utility company	West	> 250	> 2 years	Project Manager	13.07.2021	Video Call	36 min.	Financial
12	Utility company	National	> 250	> 10 years	Project Manager	14.07.2021	Video Call	57 min.	Financial
13	Independent project developer	South	< 20	> 2 years	Project Manager	15.07.2021	Video Call	74 min.	Financial
14	Utility company	West	20 - 250	> 2 years	Division Manager	20.07.2021	Video Call	68 min.	Financial

Appendix II: Interview protocol

1. Simple questions to start with

"The role of the organization and the role of the interviewee within the organization"

1.1 Can you please tell me about your role in the organization?

- Job title
- How many years of work experience do you have?
- What training did you complete before you started your current job?
- How many wind energy projects have you already completed?

1.2 Can you please tell me what renewable energy projects you are doing?

- Where does your organization operate spatially?
- Are there any common geographical/spatial characteristics between your projects?
- Are there any other common characteristics?
- What technologies?
- What business models?

"Wind energy in the context of the energy transition and climate change discussion "

1.3 What do you think of when you hear the term climate change?

1.4 What do you think of when you hear the term *Energiewende*?

1.5 In your opinion, what is the situation of wind energy in Germany?

- Compared to other energy generation technologies?
- Compared to other renewable energies?
- What advantages?
- What disadvantages?

2. Main questions - Participation

"Success factors and challenges "

2.1 What has an impact on the course and progress of wind energy projects?

2.2 Can you please tell me about your most successful project?

- What are the factors that lead to success?

2.3 What are the challenges when it comes to implementing wind energy projects? (more than one! - follow up)

- Can you please tell me how you dealt with the challenges in the past?

- Why do you think there is local opposition to wind energy projects?

"The public "

2.4 What does the term community/local population mean to you in your projects?

2.5 How do you describe your projects to the local population?

- What advantages do you mention?
- What disadvantages?

"Participation "

2.6 Thinking about what you said in the last few minutes, what do you think about local participation in wind energy projects?

- What role does participation play?
- What role does financial participation play?

2.7 How has participation changed in recent years?

"Financial participation"

2.8 What models of financial participation do you know?

2.9 Which models do you prefer?

- What role do they play in overcoming the challenges you mentioned earlier?
- Where does the initiative to offer financial participation come from?
- What does financial participation enable you to do?
- What can financial participation not do?
- What limits the use of financial participation?

"Insider tips"

2.10 Imagine I want to build a wind farm. Can you please tell me about the necessary steps?

2.11 Can you please tell me what I should definitely look out for?

3. End

3.1 Anything else? Is there anything else you'd like to share (that we haven't covered yet)?

3.2 What were your expectations before?

3.3 Can you recommend someone I could interview?

References

Ajadi, T., Cuming, V., Boyle, R., Strahan, D., Kimmel, M., Logan, M., 2020. Global Trends in Renewable Energy Investment 2020, in: Frankfurt School - UNEP Centre/BNEF (Ed.), United Nations Environment Program, Frankfurt.

Allon, G., Babich, V., 2020. Crowdsourcing and Crowdfunding in the Manufacturing and Services Sectors. Manufacturing & Service Operations Management 22, 102-112.

Beery, J.A., Day, J.E., 2015. Community investment in wind farms: funding structure effects in wind energy infrastructure development. Environ Sci Technol 49, 2648-2655.

Bergek, A., Mignon, I., Sundberg, G., 2013. Who invests in renewable electricity production? Empirical evidence and suggestions for further research. Energy Policy 56, 568-581.

Braun, V., Clarke, V., 2006. Using thematic analysis in psychology. Qualitative Research in Psychology 3, 77-101.

Broughel, A., Wüstenhagen, R., 2022. The Influence of Policy Risk on Swiss Wind Power Investment, Swiss Energy Governance, pp. 345-368.

Côté, E., Đukan, M., Pons-Seres de Brauwer, C., Wüstenhagen, R., 2022. The price of actor diversity: Measuring project developers' willingness to accept risks in renewable energy auctions. Energy Policy 163.

Cowell, R., Bristow, G., Munday, M., 2011. Acceptance, acceptability and environmental justice: the role of community benefits in wind energy development. Journal of Environmental Planning and Management 54, 539-557.

Curtin, J., McInerney, C., Gallachóir, B.Ó., Salm, S., 2019. Energizing local communities—What motivates Irish citizens to invest in distributed renewables? Energy Res. Soc. Sci. 48, 177-188.

Deutsche WindGuard, 2015. Akteursstrukturen von Windenergieprojekten in Deutschland, in: WindEnergie, B. (Ed.), Berlin.

Ebers Broughel, A., Hampl, N., 2018. Community financing of renewable energy projects in Austria and Switzerland: Profiles of potential investors. Energy Policy 123, 722-736.

Enevoldsen, P., Sovacool, B.K., 2016. Examining the social acceptance of wind energy: Practical guidelines for onshore wind project development in France. Renewable and Sustainable Energy Reviews 53, 178-184.

Goedkoop, F., Devine-Wright, P., 2016. Partnership or placation? The role of trust and justice in the shared ownership of renewable energy projects. Energy Res. Soc. Sci. 17, 135-146.

Graham, J.R., Harvey, C.R., 2001. The theory and practice of corporate finance: evidence from the field. Journal of Financial Economics 60, 187-243.

Holstenkamp, L., 2014. Local investment schemes for renewable energy: A financial perspective, Renewable Energy Law in the EU, pp. 232-255.

IRENA, 2020. Mobilising institutional capital for renewable energy. International Renewable Energy Agency, Abu Dhabi.

Kerr, S., Johnson, K., Weir, S., 2017. Understanding community benefit payments from renewable energy development. Energy Policy 105, 202-211.

Lam, P.T.I., Law, A.O.K., 2016. Crowdfunding for renewable and sustainable energy projects: An exploratory case study approach. Renewable and Sustainable Energy Reviews 60, 11-20.

Lazard, 2021. Lazard's Levelized Cost of Energy analysis - Version 15.

Leer Jørgensen, M., Anker, H.T., Lassen, J., 2020. Distributive fairness and local acceptance of wind turbines: The role of compensation schemes. Energy Policy 138.

Lienhoop, N., 2018. Acceptance of wind energy and the role of financial and procedural participation: An investigation with focus groups and choice experiments. Energy Policy 118, 97-105.

Linnerud, K., Toney, P., Simonsen, M., Holden, E., 2019. Does change in ownership affect community attitudes toward renewable energy projects? Evidence of a status quo bias. Energy Policy 131, 1-8.

Mazzucato, M., Semieniuk, G., 2018. Financing renewable energy: Who is financing what and why it matters. Technological Forecasting and Social Change 127, 8-22.

Mollick, E., 2014. The dynamics of crowdfunding: An exploratory study. Journal of Business Venturing 29, 1-16.

Musall, F.D., Kuik, O., 2011. Local acceptance of renewable energy—A case study from southeast Germany. Energy Policy 39, 3252-3260.

Paschen, J., 2017. Choose wisely: Crowdfunding through the stages of the startup life cycle. Business Horizons 60, 179-188.

Rin, M.D., Hellmann, T., Puri, M., 2013. A Survey of Venture Capital Research, pp. 573-648.

Rossi, M., 2014. The New Ways to Raise Capital: An Exploratory Study of Crowdfunding. International Journal of Financial Research 5.

Ruddat, M., 2022. Acceptance of wind energy – Theoretical concepts, empirical drivers and some open questions. Wind Energy Science [preprint].

Salm, S., Hille, S.L., Wüstenhagen, R., 2016. What are retail investors' risk-return preferences towards renewable energy projects? A choice experiment in Germany. Energy Policy 97, 310-320.

Schlosberg, D., 2007. Distribution and Beyond: Conceptions of Justice in Contemporary Theory and Practice, Defining Environmental Justice. Oxford University Press, Oxford, pp. 11-40.

Solman, H., Smits, M., van Vliet, B., Bush, S., 2021. Co-production in the wind energy sector: A systematic literature review of public engagement beyond invited stakeholder participation. Energy Res. Soc. Sci. 72.

Stede, J., Blauert, M., May, N., 2021. Way Off: The Effect of Minimum Distance Regulation on the Deployment and Cost of Wind Power. SSRN Electronic Journal.

Strachan, P.A., Cowell, R., Ellis, G., Sherry-Brennan, F., Toke, D., 2015. Promoting Community Renewable Energy in a Corporate Energy World. Sustainable Development, n/a-n/a.

Szulecki, K., 2017. Conceptualizing energy democracy. Environmental Politics 27, 21-41.

Vuichard, P., Stauch, A., Dällenbach, N., 2019. Individual or collective? Community investment, local taxes, and the social acceptance of wind energy in Switzerland. Energy Res. Soc. Sci. 58.

Walker, C., Baxter, J., 2017. "It's easy to throw rocks at a corporation": wind energy development and distributive justice in Canada. Journal of Environmental Policy & Planning 19, 754-768.

Warren, C.R., Lumsden, C., O'Dowd, S., Birnie, R.V., 2005. 'Green On Green': Public perceptions of wind power in Scotland and Ireland. Journal of Environmental Planning and Management 48, 853-875.

Weiler, K.W., Andreas ; Grashof, Katharina ; Holstenkamp, Lars ; Ehrtmann, Moritz, 2021. Entwicklung und Umsetzung eines Monitoringsystems zur Analyse der Akteursstruktur bei Freiflächen-Photovoltaik und der Windenergie an Land : Abschlussbericht: Ergebnisse des Monitorings und Empfehlungen, in: Werlein, M.F., Matthias (Ed.). Umweltbundesamt, Dessau-Roßlau

Wind Europe, 2021. Wind energy in Europe 2020. Statistics and the outlook for 2021-2025.

Wüstenhagen, R., Wolsink, M., Bürer, M.J., 2007. Social acceptance of renewable energy innovation: An introduction to the concept. Energy Policy 35, 2683-2691.

Yildiz, Ö., 2014. Financing renewable energy infrastructures via financial citizen participation – The case of Germany. Renewable Energy 68, 677-685.

Paper III

A matter of acceptability? Understanding citizen investment schemes in the context of onshore wind farm development[14]

Jakob Knauf[15][16] and Julia le Maitre[17]

Abstract

Governments have set ambitious targets for low-carbon electricity, supported by policies that aim at accelerating the expansion of renewables like onshore wind energy. In-step with these developments it is acknowledged that community acceptance is an important factor. One measure deemed increasingly important for community acceptance is to encourage joint investments between local communities and wind farm developers. Through a literature review this study considers the synergies and mismatches of joint investments from residents, here referred as citizen investments, into commercial developer-led wind farms. The practice of citizen investment into commercial wind developments is relatively novel but is becoming more relevant under policies which promote citizen involvement in energy actions, such as the European Union's Renewable Energy Directive. This study conceptualizes citizen investments in the context of community acceptance to understand how it translates into eligibility criteria in different political and academic settings. This study finds that citizen investment has a positive relationship with community acceptance, but the link is conditional rather than automatic. This study sees the need to further elaborate on the nature of the relationship and highlights opportunities to bring together a variety of methodological, temporal and geographic approaches and theoretical concepts,

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considering the eligibility criteria and the trade-off between risks of citizen investments and control of projects.

Keywords: wind energy, citizen investment, social acceptance, ownership, community energy, participation, literature review

1. Introduction

The growing urgency to constrain global warming to 2°C above pre-industrial levels (Intergovernmental Panel on Climate Change, 2022) has seen policies in many countries of the global north aim to increase the share of renewable energy sources to displace reliance on fossil fuels (International Renewable Energy Agency et al., 2018). In many instances, national policy has set wind energy installation targets, which are anticipated to double current wind capacity by 2030 (Jørgensen et al., 2021). An important driver for the development of onshore wind farms can be the extent to which they are accepted by the community living near to a proposed site. Community acceptance is considered a prerequisite and accelerator for the continued expansion of wind energy (Wüstenhagen et al., 2007). Given that the largescale deployment of renewable energy requires the involvement of established incumbents (Mumford and Gray, 2010; Baker et al., 2021) (e.g., municipal utilities, professional developers, multinational energy companies), policymakers and developers have introduced strategies to include citizens in the development of a project to foster community acceptance (Haggett et al., 2014; Gjørtler Elkjær et al., 2021). The policies have led to the emergence of a variety of collaborative models between local citizens and professional developers, including the opportunity for citizens to invest in local wind turbines. (Walker and Devine-Wright, 2008; Baxter et al., 2020). The practice of citizen investment has expanded alongside the application of renewable energy auction policies, particularly in Europe (Grashof, 2019; Côté et al., 2022).

A number of high-potential wind regions have either implemented, formalized or proposed citizen investment models, including Denmark (Rønne and Gerhardt Nielsen, 2019), Canada (Department of Energy Nova Scotia, 2010), Scotland (Slee, 2015), South Africa (Haggett et al., 2014). These examples emphasize the role of citizen participation and stakeholder benefit within the framing of a just transition agenda (European Parliament and Council of Europe, 2018; International Renewable Energy Agency, 2020; Wahlund and Palm, 2022). This study focuses on community acceptance

in the context of collaborative approaches to wind farm development requiring citizen investment which could contribute to the Sustainable Development Goals 7 (renewable energy), 13 (climate action), 9 (innovation and infrastructure) 16 (peace, justice and strong institutions).

Understanding why and under which conditions citizen investment influences the local acceptability of a largescale wind farm (i.e., the level of support from within a group of nearby residents) is an important question for academics, policymakers, and developers, and has been proposed as an important consideration for the community acceptance of wind energy (Holstenkamp, 2014; Ferraro and Ellis, 2017; von Wirth et al., 2018; Hall et al., 2019; Mey and Hicks, 2019). The review examines the ways in which citizen investment is interpreted and discussed with focus on the representation of eligibility considerations within the research. This review identifies implications for policy and future research regarding the local acceptability of citizen wind energy investment models.

With focus on projects owned by people living within a specific geographic area, Baxter et al. (2020) and Lowitzsch et al. (2020) have identified common themes which influence citizens' involvement in renewable energy developments. Each of these papers gives focus to common issues, including (i) actor representation and the heterogeneity of investors; (ii) the proximity criteria describing how far an investor lives from a development; (iii) the distribution of ownership rights governing the asset and (iv) the legal framework and formal voting structures which determine who is eligible to engage in, or vote on, renewable energy developments. In recent years, European policy under the Recast Renewable Energy Directive, Clean Energy Package and Green Deal have seen a greater number of hybrid arrangements emerge to share the ownership of a particular project between larger-scale market players and citizen initiatives within a certain geography. As various approaches have noted, citizen investment requires trade-offs between different criteria for local acceptance (Knauf and Wüstenhagen, 2023). Within this context, the review aims to test the hypothesis that community acceptance is positively enhanced by citizen investment mechanisms. To examine community support for citizen investment, the analysis gives specific focus to their defining eligibility criteria. The study asks:

1. How is citizen investment into wind farms translated into eligibility criteria?
2. Are there common lessons as to the perceived local acceptability of a citizen investment scheme?

To address these aims, this study identifies papers that concern citizen investment or related local investment schemes ('community ownership' or 'co-ownership') into onshore wind farms through a systematic approach of original research published until June 2022. This paper proceeds as follows. Section 2 describes the emergence of citizen investment into wind farms. Section 3 contains details about the methodology and review approach and subsequently, Section 4 contrasts and discusses the findings of each paper. Section 5 contains a conclusion of the core findings and opportunities for future research.

2. Background: Types of citizen investment into wind farms

Financing the energy transition depends critically on tapping new types of financing sources (Rossi, 2014; Curtin et al., 2017), including citizen investment from remote or even international investor pools. Citizen investments are hybrids between fully community and developer owned projects (International Renewable Energy Agency, 2020) in which investors and investments are extending over increasingly disperse geographic scales. They require the citizens to make an active contribution to a wind farm by investing their own capital in the project (Solman et al., 2021).

Citizen investments have some advantages for the community compared to projects that they develop on their own (community energy). Haggett and Aitken (2015) report that communities have difficulties in securing finance and that perceived risks of projects create challenges. Recently, policy changes including the introduction of auctions that replace feed-in tariffs in more and more countries puts additional challenges on community energy (Grashof, 2019; Côté et al., 2022). Hinshelwood (2001); Haggett and Aitken (2015) have described that a cooperation between developers and the local community in a project does not require the community to bear the full risks, resources, knowledge, time, and start-up capital by themselves as if they develop the project on their own. A developer usually has more resources (Krug and Di Nucci, 2020) and can bear some project risks if a community and a developer enter into a citizen investment scheme and share ownership of the wind farm together (Strachan et al., 2015; Đukan and Kitzing, 2021). Citizen investments therefore provide financial benefits to communities and use the capacity that usually only established market players have (Hockerts and Wüstenhagen, 2010).

Table 1 shows various forms of citizen investment allowing different degrees of formal voting rights and control. Equity (i.e., common equity) is a traditional equity investment, which grants the shareholder proportional voting rights (Wind Europe, 2021). Citizen investors may purchase shares in a project as an individual. Different arrangements are possible, for instance split ownership (Shared Ownership Task Force, 2014; Curtin et al., 2019) and limited partnership (Holstenkamp, 2014). A common alternative is a cooperative structure under 'one person, one vote' rules (Morris, 2019). Investments in equity are quite risky for citizen investors "because the owners are the party responsible for bringing the initial concept idea through development, construction and commercial operation" (p. 10) (Wind Europe, 10, 2021). Crowdfunding in debt and bonds usually come at a later project phase (Knauf and Wüstenhagen, 2023). Investors do not have to bear the same risks as (early) equity investments, and do not necessarily gain legal voting rights. Similarly, preference equity and shared revenue agreements (Shared Ownership Task Force, 2014; McInerney and Curtin, 2017), (profit) participation rights and subordinated loans (Holstenkamp, 2014) do not automatically confer voting rights to citizens on a legal basis. As such, the appointment of a local representative to meetings concerning majority private project developments is done on a voluntary basis, as part of wider stakeholder engagement strategies. In some instances, a public body such as the municipality might make an investment on behalf of residents in the area (Holstenkamp, 2014; Lowitzsch, 2020), for example through a joint venture (Shared Ownership Task Force, 2014; McInerney and Curtin, 2017).

These citizen investment arrangements are distinguished from other forms of benefit-sharing arrangements in which the developer provides financial benefits to individuals (e.g., discounts on electricity, compensation for property value-loss) or collectively for the community as whole (e.g., local community benefit fund). Similarly, contributions might be made in-kind, such as local projects for infrastructure development, facilities, or services.

Table 1: Overview of citizen investment models and benefit-sharing schemes from developer-owned onshore wind farms.

	Citizen investment models	Benefit schemes
Definition following Kerr et al. (2017)	"Financial benefit is directly linked to the profitability of the development"	Provided from the developer as "standardised payments / internal budget allocation"
Citizens/individuals **(Payment made *directly* to citizens / individuals**	***Equity*** Split ownership (Shared Ownership Task Force, 2014; The Scottish Government, 2019) Cooperatives (Bauwens and Devine-Wright, 2018) Shared equity (van Veelen, 2016) Joint ventures (Shared Ownership Task Force, 2014; van Veelen, 2016; The Scottish Government, 2019) ***Debt/crowdfunding*** Revenue-sharing agreements/ Shared Revenue (Shared Ownership Task Force, 2014; The Scottish Government, 2019)	Discounted electricity (García et al., 2016; Knauf, 2022) Compensation (Aitken, 2010; Brennan and Van Rensburg, 2016)
A defined group of recipients **(Payment made *indirectly* to the community)**	***Equity*** Municipal stakeholders, e.g., shareholding through public utilities (Mergner and Rutz, 2014; Roberts et al., 2014) Trusts (Simcock, 2013)	Community benefit fund (Aitken, 2010; Cowell et al., 2011) Payments to municipalities and benefits in kind (Bristow et al., 2012; Devine-Wright and Sherry-Brennan, 2019), e.g., sponsoring of associations or local community facilities (e.g. kindergartens, swimming pools, scholarships)

Kerr et al. (2017) describe that citizens' entitlement to financial benefits from onshore wind farms can be contingent on the voluntary contribution of a developer or formalized on a legal basis. The state of Mecklenburg-Western Pomerania (Yildiz et al., 2019) or the COMFIT program in Nova Scotia (Department of Energy Nova Scotia, 2010) are two examples where citizen investments are mandated or at least strongly encouraged by the legislative authority. However, citizen investments are in most instances voluntary and the type of arrangement is freely negotiable between the project developer and the local community (Regen, 2014; Wokuri et al., 2019). A major

motivation for developers to offer citizen investments on a voluntary base is the aim to enhance community acceptance (Fast et al., 2016).

3. Methodology

To contribute to a fuller understanding of how the implementation of citizen investment into onshore wind influences community acceptance of these projects, this study is a review of empirical research published to June 2022. The research problem involves the identification and comparative case review of literature which considers the locality, participatory and distributive implications of shared wind farm development by local citizens and professional developers through citizen investment into a particular wind farm asset, with attention to relevant frameworks on the topic (i.e. Walker and Devine-Wright (2008); Baxter et al. (2020); Lowitzsch et al. (2020)).

3.1. Approach to the review

This review sourced relevant empirical studies from three comprehensive journal search engines (Web of Science, Scopus and Google Scholar). Papers were screened along criteria consistent with the PRISMA principles (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) (Page et al., 2021). The PRISMA methodology is considered best practice for reproducibility and quality of analysis. The Boolean search criteria shown in Table 2 were used to identify relevant empirical research.

Table 2: Search word combinations.

(First tier)	**AND (Second tier)**	**AND (Third tier)**	**AND (Fourth tier)**
Wind	Acceptance	Investor	Individual
	OR	OR	OR
	Acceptability	Investment	Private
	OR	OR	OR
	License	Invest	Community
			OR
			Citizen
			OR
			Local

The search query criteria were selected as follows. This work focuses on the emerging practice of citizen investment into onshore wind energy under the first tier search term "wind". Second, since this paper deals with citizen investment, keywords "investor", "investment", and "invest" are included in the second tier. Wider exploratory search queries also considered "ownership", "cooperative", "crowdfunding" and "finance" as

keywords and were found to be unnecessary from review at a preliminary stage since relevant papers were already found using the keywords given in Table 1. Third, the paper considers the local community and its individuals. The keywords "local," "private," "individual," "citizen," and "community" were intended to ensure that local (i.e., potential investors associated with a community of locality) made up the sample. This excludes studies concerning 'distant' investors from further away, such as institutional or professional investors. The fourth tier search term addresses community acceptance of wind energy. Therefore, "acceptance" is used as a key search term for all search phrases and in most instances served to exclude purely technical papers about wind energy. Further to this, preliminary analysis revealed contextual particularities, for instance referring to community acceptance as a "social licence to operate" (Hall, 2014) and a subset of European studies which focalized on this manifestation as levels of "acceptability" (Dimitropoulos and Kontoleon, 2009; Strazzera et al., 2012; Schroeter et al., 2016). For robustness, these terms and alternative spellings were added into the search expansion criteria outlined in Table 2. However, any research outside of these criteria would not have been included in the identified sample taken forward for analysis.

3.2. Identifying relevant empirical studies

Figure 1 shows a numerical summary of the screening process. In total, the search by keywords yielded 138 publications in Web of Science and 67 in Scopus, which resulted in 142 unique search results. The initial relevant sample (142) was analyzed for term co-occurrence using bibliometric clustering in VOSviewer to show links between keyword and title terms (Figure A.1). A total of 740 terms were identified using a full counting approach, and 71 occurred at minimum 3 times. Of the 5 identified clusters, 4 respectively contained dominant co-occurrence nodes at "investments", "wind power", "energy policy" and, having emerged more recently (average publication year 2016 onwards), "social acceptance" connected to "community acceptance". Based on the co-occurrence map analysis and after screening titles and abstracts of the relevant sample, studies were shortlisted under inclusion/exclusion criteria to a potentially eligible list of 18 original empirical journal articles.

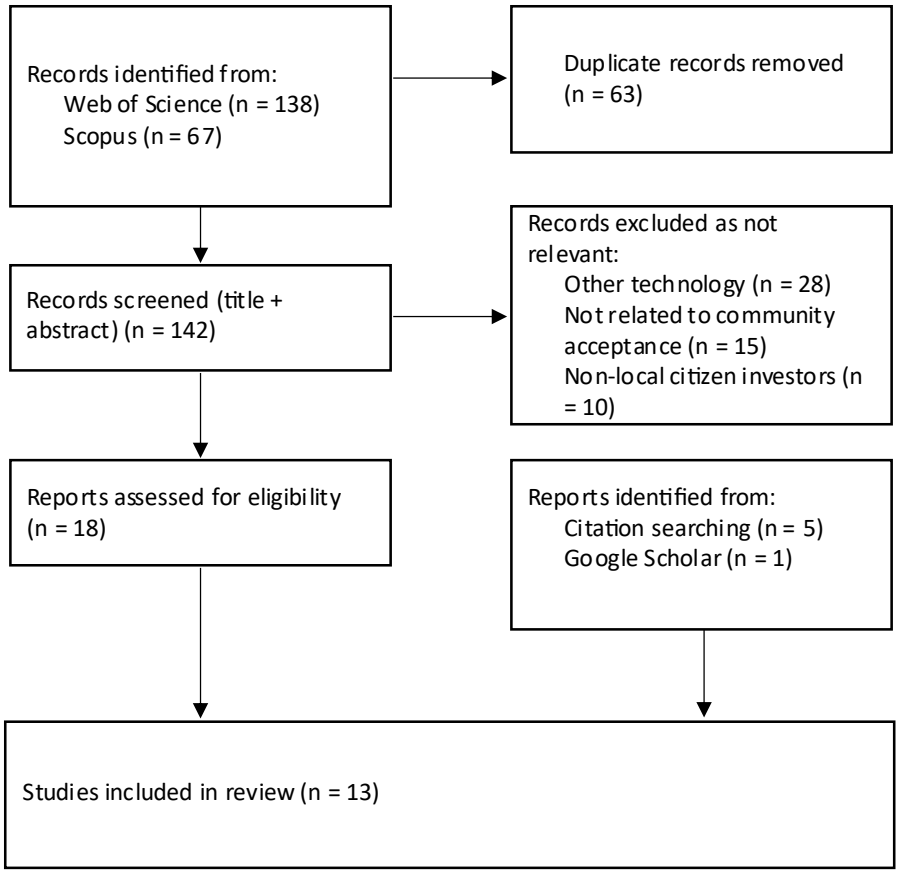

Figure 1: Overview of the screening process.

An analysis of these 18 full papers resulted in seven papers from the databases. The final sample of 13 papers contains these seven papers and additionally one from Google Scholar and five from citation searching.

Figure 2 summarizes the inclusion and exclusion process undertaken to identify a sample of relevant studies. Empirical papers presenting original quantitative, qualitative, and mixed methods evidence were included. Reviews and conceptual papers are only used as a source for references in the snowballing procedure to identify further relevant publications or for conceptual considerations.

The inclusion and exclusion of papers was as follows. First, the state of energy systems concerning security of supply, affordability and environmental compatibility and the challenges related to the energy transition vary greatly between countries (Koirala et al., 2016). To have a coherent sample of papers in terms of development status of the considered energy system and associated challenges to community acceptance of the transition, this study only considers countries which have similar preconditions. It uses the Energy Transition Index 2020 as a proxy for the analysis and focus on advanced economies with established energy systems (World Economic Forum, 2020).

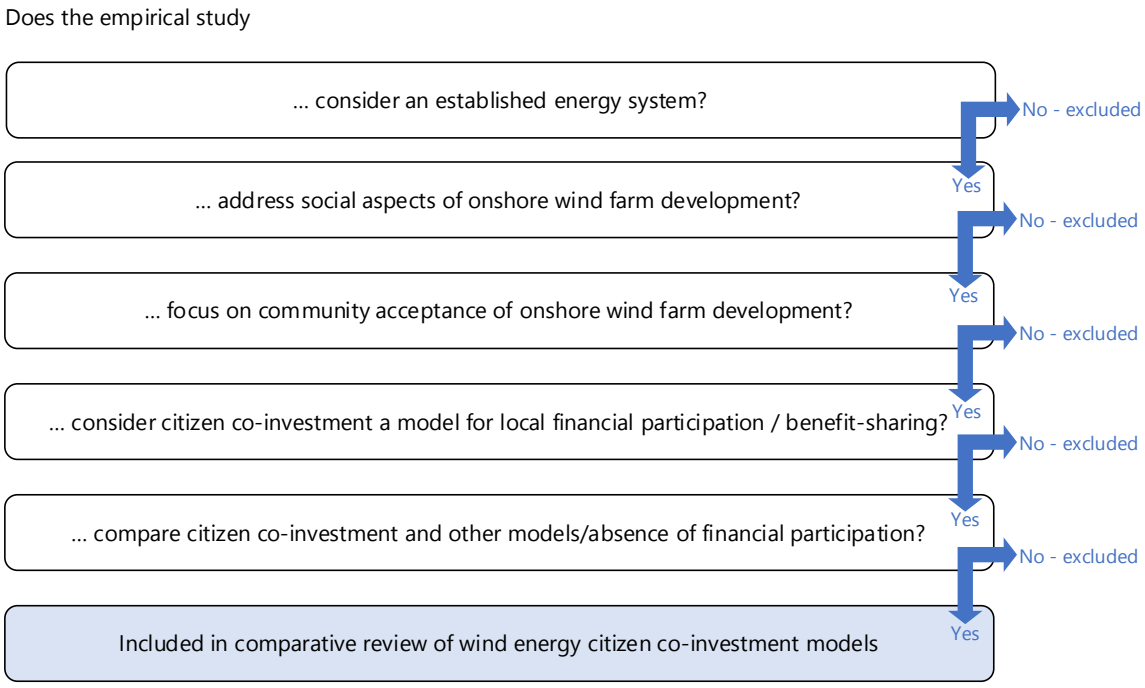

Figure 2: Aims of inclusion and exclusion criteria applied during screening to identify relevant studies.

Second, this study considers onshore wind energy development only, as there are significant differences in the typical investment scale (Wind Europe, 2021) and proximity between residents and turbines (Krueger et al., 2011) compared to offshore wind farms. Papers that addressed at least two different forms of financial participation are included, to consider citizen investment in the context of an alternative financial participation scheme. Therefore, included studies concerned (1) at least two citizen investment models, or (2) a citizen investment model and a benefit scheme, or (3) a citizen investment model in contrast to no financial participation scheme.

Two independent researchers were involved in the selection, analysis and cross-comparison of the findings of the collected papers and all articles deemed relevant were considered by qualitative analysis (Petticrew and Roberts, 2006). shows the sample of papers included in the review.

Table 3: Overview of the reviewed paper.

Papers	Country / case	Method	Population and sample size	Proximity to the project	Sample strategy	Analysis
Warren and McFadyen (2010)	Scotland	Ex post 1) Questionnaire-based survey (online and paper) 2) Semi-structured face-to-face interviews	1) Local residents (n = 68) 2) Tourists (n = 38) of the isle of Gigha and Kintyre peninsula 3) Interviews with key stakeholders (n = 5)	Approximately 4-6 km	Non-probability sampling: 1) Door-to-door 2) Face to face (downtown) 3) Online	Descriptive
Musall and Kuik (2011)	Germany	Ex post Questionnaire-based survey (in-person)	1) Nossen residents (n = 100) 2) Zschadraß residents (n = 100)	Close proximity to the community and 2 km (but not visible)	Door-to-door interviews following letter circulated by respective mayors (samples confirmed equivalent in age, gender and level of education)	Kruskal–Wallis one way analysis of variance
Goedkoop and Devine-Wright (2016)	United Kingdom	Ex post 1) Semi-structured interviews (face-to-face and telephonically) 2) Informed by community energy seminar	Shared ownership stakeholders: 1) Renewable energy companies (n = 7) 2) Community actors involved in specific projects (n = 6) 3) Intermediaries for advisory/support (n = 6)	Policy focus (Refers to Danish case: within 4.5 km)	Snowball sampling through a referral system	Interviews coded for thematic analysis of discourse from a social constructionist perspective using Atlas.ti
Mostegl et al. (2017)	Germany	Ex ante 1) Three workshops (informative format) 2) Questionnaire-based survey and a choice experiment (online and paper)	Households in community of Langqauid (n = 231)	56.6 km^2 covering the community border as per OpenStreetMap	Total population: 1) Mailshot-invitation 2) Questionnaire link on social media platform 3) Questionnaires at local organizations and businesses	Latent class choice model
Langer et al. (2017)	Germany	Ex ante Choice experiment with survey through web-survey	National (n = 1363)	Attribute levels from 0 – 0.5 km to > 10 km of attribute distance	Quota Sampling: Respondents filtered by degree of experience with participation in wind energy by market research company	Multinomial logit choice model using Hierarchical Bayes estimation

Table 3 (continued).

Papers	Country / case	Method	Population and sample size	Proximity to the project	Sample strategy	Analysis
Brennan et al. (2017)	Ireland	Ex ante Five focus groups (in person) and a public survey	1) Residents who live near windfarm (n = 13), Wind farm developers (8) and 2) Individuals in case study locations (n = 200)	Close proximity to the community	1) Voluntary response sampling after pre-survey for focus group, 2) not specified survey	1) Not specified in detail (focus groups) and 2) Descriptive (survey)
Walker and Baxter (2017)	Canada	Ex post Comparative case study of Nova Scotia and Ontario communities using interviews and survey	1) Focus groups: Residents of cases residents living within 2 km of a wind turbine (n = 31), Municipal leaders (n = 10), Developers (n = 7), and Policy experts (n = 6) 2) Quantitative survey: Ontario (n = 127) and Nova Scotia (n = 113) residents within 2km	Residents within 2 km of a turbine	1) Voluntary response to mailshot-invitation and snowball sampling through a referral system 1) Random mailshot-invitation to residents living within 2km of a turbine across 10 communities	1) Interviews coded using inductive grounded theory approach in NVivo 2) Survey data analyzed by t-tests and regression
Hyland and Bertsch (2018)	Ireland	Ex ante Online survey	National (n = 1044)	Public focus	Random sampling from panel book by market research company	Ordered logit model
Lienhoop (2018)	Germany	Ex ante 1) Choice experiments 2) Focus groups	1) Residents in three villages with significant wind energy potential in the federal states Saxony (n = 15), Saxony-Anhalt (n = 15) and Hesse (n = 15) 2) Rural residents living in communities with wind energy potential (n = 388)	Public focus	Sampling by market research company to ensure even age and gender distribution	1) Descriptive analysis (focus groups) 2) mixed logit choice model
Vuichard et al. (2019)	Switzerland	Ex ante Online experimental survey	National (n = 1202)	Public focus	Random sampling from panel book by market research company	Analysis of variance (ANOVA)

Table 3 (continued).

Papers	Country / case	Method	Population and sample size	Proximity to the project	Sample strategy	Analysis
Leer Jørgensen et al. (2020)	Denmark	Ex post Comparative case study of three projects in west, east and south Denmark using focus groups and semi-structured interviews	Citizens of the three case studies (two focus groups for each case: n = 46, Interviews: n = 14)	Community focus (policy case: eligible within 4.5km, with donated shares to households within 1km)	Purposeful sampling based on distance to turbine, citizens identified through newspaper articles, word-of-mouth, and Google Maps and followed-up by telephone contact.	Interviews coded for thematic analysis of (1) perceptions of wind projects and (2) distributive fairness of compensation schemes in NVivo to draw a Toulmin's model of a simple argument combined with a hermeneutics-inspired meaning interpretation
Tanujaya et al. (2020)	South Korea	Ex ante 1) Choice experiment and survey of general public 2) Face-to-face interviews of local residents	1) National sample (n = 508) 2) Residents within 1 km of renewable energy projects (n = 306)	Comparative focus: Public sample and within 1km	1) Random proportional quotas (national) 2) Purposive quota (residents)	Multinomial logit choice models
Vuichard et al. (2022)	Switzerland, Estonia and Ukraine	Ex ante Choice experiment and survey (online)	National: Switzerland (n = 1003), Ukraine (n = 500) and Estonia (n = 500)	Public focus	Random sampling from panel book by market research company	Multinomial logit choice model using Hierarchical Bayes estimation

4. Results and discussion

This analysis is contained within the search criteria established at the beginning of the research, and therefore it is necessary to note the limitations of the data that may influence the results. Much of the identified research focuses on policy cases that already have some experience with citizen investment. It is conceivable that there are other countries that have introduced citizen investment but are not represented, for instance where this has not met with much social interest or where citizen participation in renewable energy development is novel. The underrepresentation of empirical papers on the topic beyond Northern America and Europe has been recognized elsewhere (Wahlund and Palm, 2022). Limitations of this nature commonly arise with socially innovative topics and highlights new areas of research which might make generalization possible in the future.

4.1. Terminology applied to citizen investment into wind farms

The findings presented in Table 4 highlight that citizen investment into wind farms covers a varied terminology and a number of debt/equity financial investment mechanisms. Illustratively, several papers use more than one term to refer to citizen investment within the text.

Citizen investment into wind farms is commonly referred to in the literature as "community/local (co-)ownership" (Warren and McFadyen, 2010; Musall and Kuik, 2011; Brennan et al., 2017; Mostegl et al., 2017; Walker and Baxter, 2017; Lienhoop, 2018; Leer Jørgensen et al., 2020; Tanujaya et al., 2020; Vuichard et al., 2022). This suggests that studies concerned with citizen wind energy investment has drawn on the terminology introduced under the earliest citizen investment policy, Denmark's Co-ownership Scheme (Leer Jørgensen et al., 2020), even if in practice some citizen investors do not feel a sense of "ownership" of the project and the investment may be sourced from outside of the "local" community (Walker and Baxter, 2017).

Table 4: Overview of the eligibility criteria of the reviewed papers.

Papers	Terminology applied to citizen investment	Actor representation	Conceptualization of proximity criteria	Distribution of ownership rights	Type of model and control (legal framework)
Warren and McFadyen (2010)	Community ownership	1) Community raises capital cost through three-way mix of grant funding, commercial loan finance and equity finance 2) Commercial developer	Community of place (islands)	1) Wholly owned by the community 2) Commercial developer	1) Community-owned windfarm 2) Developer-owned windfarm
Musall and Kuik (2011)	Community ownership Co-ownership	1) Community through a community club and a foundation. 2) Commercial developer	Community of locality	Community co-ownership (80% owned by developer, 15% belong to a foundation and 5% belong to the club 'rural life' (equals 20% ownership through the community)	1) Community co-ownership 2) Commercial wind farm
Goedkoop and Devine-Wright (2016)	Shared ownership Citizen participation	Community and commercial developer	Communities (defined as a collective rather than an aggregate of individuals)	Local share between 5 and 25 %	1) Community-owned wind farm: 2) commercial wind farm with elements of shared ownership and control
Mostegl et al. (2017)	Community ownership	Community and investor	Residents of municipality	Community ownership model not specified	1) Community ownership model 2) External investor model 3) Household Savings from Revenue in community ownership model (10%, 25%, 35%, 50%) 4) Price of electricity
Langer et al. (2017)	Active participation through financial investment	Community and commercial developer	Neighborhood	Not specified	Financial investment
Brennan et al. (2017)	Investment by local residents Co-ownership Ownership by the community	Community and commercial developer	Affected public: local community who lives in proximity to a wind farm/planned wind farm	Not specified but one suggestion: 10% open to community	1) Community co-ownership 2) Compensation 3) investment with guaranteed return

Table 4 (continued)

Papers	Terminology applied to citizen investment	Actor representation	Conceptualization of proximity criteria	Distribution of ownership rights	Type of model and control (legal framework)
Walker and Baxter (2017)	Minority or majority community ownership Community-based development	Community and commercial developer	Community of place, citizen investors are not necessarily local	Different; from 0 to majority stake (51%)	1) Community-owned (compensation and investment (CEDIF in Nova Scotia)) 2) Developer-led with very little profit sharing with community (mainly Ontario)
Hyland and Bertsch (2018)	Joint venture Equity involvement Shared ownership	Community and commercial developer	Residents of the local communities	Not specified	1) Community benefit scheme 2) Equity involvement (co-ownership) 3) Joint ventures (co-ownership) 4) Energy cooperatives (community ownership)
Lienhoop (2018)	Financial participation Co-ownership through shareholding	1) National (large enterprise) 2) Regional (e.g., public services) 3) Local (e.g., community wind park)	Rural residents	Not specified	1) Option to buy shares (co-ownership) 2) No option to buy shares
Vuichard et al. (2019)	Community investment via shares or bonds	Local project developer and residents of the local communities	Residents of the local communities	1) Individuals, community members 2) Individuals, community members 3) Community as a whole	1) Wind share (co-ownership) 2) Wind bond 3) Wind resource tax
Leer Jørgensen et al. (2020)	Co-ownership schemes	External developer and external and local investors.	Local citizens within 900 m, 4.5 km and more than 4.5 km	Three cases: from fully owned by local citizens to less than 10%	1) Property value-loss scheme 2) Co-ownership scheme 3) Green scheme (community benefit)
Tanujaya et al. (2020)	Community-based Bond investment Equity investment	Not specified	Residents within 1 km	Not specified	Bond investment Equity investment (co-ownership)
Vuichard et al. (2022)	Local ownership Cooperation Revenue sharing	Residents and commercial developer	Residents of the local communities	(1) Individual(s) from the region (2) Local electric utility (3) Cooperation between local utility and a specialized investor	1) No benefits to local community 2) Benefit-sharing with local landowner 3) Benefit-sharing with municipality 4) Benefit-sharing with individual residents

Procedural dimensions of ownership are explicitly brought to the fore in four instances. For example, this strand of the literature describes citizen investment as "cooperation" models (Vuichard et al., 2022), and "shared ownership" arrangements (Goedkoop and Devine-Wright, 2016; Hyland and Bertsch, 2018) which encourage "citizen participation" in the energy transition. Procedural aspects are especially evident for research focusing on Germany, with citizen investment into wind farms referred to as a mode of "financial participation" (Lienhoop, 2018) and "active participation through financial investment" (Langer et al., 2017).

Alongside this, another focus within the literature considers the specific ways in which shareholding is structured, for instance through a "joint venture" (Hyland and Bertsch, 2018), "investment by local residents" (Brennan and van Rensburg, 2020), "equity investment/involvement" (Warren and McFadyen, 2010; Hyland and Bertsch, 2018; Tanujaya et al., 2020), "(wind) bonds" (Vuichard et al., 2019; Tanujaya et al., 2020), and "revenue sharing" (Vuichard et al., 2022). This indicates that there are a number of financial mechanisms to enable citizen investment into wind farms owned by commercial wind farm developers, each of which carries specific implications and limits for the extent of citizen involvement in the project.

4.2. How is citizen investment into wind farms translated into eligibility criteria?

The following sections aim to distinguish how these different papers define citizen investment models in terms of (i) actor representation; (ii) the conceptualization proximity criteria applied to include stakeholders; (iii) the distribution of ownership rights governing the asset, and (iv) the legal framework which determine who is eligible to vote.

In some cases, where the national legal requirements for citizen investments have not been unified or their access has not been restricted, there is evidence to suggest it is not necessarily the local community that invests and benefits to the greatest extent from citizen investment models. Citizen investment, even if framed as community ownership, does not necessarily mean such a "community" comprises residents in the immediate vicinity of a project. As Musall and Kuik (2011) state, the distinction "between communities of interest" and "communities of localities" is crucial for answering who invests and benefits (p. 3253). Profits in their community co-owned case are used to "reduce the fees for the local kindergarten, thus providing financial relief to the parents (p. 3255). Warren and McFadyen (2010) state that "potential

economic benefits (…) can flow to locals from community ownership (…) involving job creation, in-migration and growing numbers in the local school" (p. 210). This perception of "local benefits" regards the whole community and might reflect that the funding comes not directly from individuals but from a local trust. Citizens could not invest directly.

Some papers define the community eligible to invest geographically, and point to local citizens as the community living within a given radius of a wind project. Tanujaya et al. (2020) performed a survey of "local residents" living in administrative areas "within 1km" of renewable energy infrastructure (p. 6) for a South Korean sample. Leer Jørgensen et al. (2020) discusses the rescinded Danish co-ownership Scheme (2008-2018) which required developers to offer 20% of a project to "local [permanent residents] within 4.5 km" (p. 4) as purchasable shares priced at closing bid (cost) price.

Walker and Baxter (2017) discuss local perceptions of different wind energy projects in Ontario and Nova Scotia through interviews and surveys with "residents living within 2 km of a wind turbine" under different community-based ownership policies. The study presents various aspects of the Nova Scotia Community Feed-in Tariff scheme (COMFIT). It highlights that in some investment options (i.e., the Community Economic Development Investment Fund, CEDIF, only 25 investors and 6 directors must be from the "defined community", while "the rest can be from anywhere in the province" (p. 761). Interviewed policy experts and residents confirmed that investors are generally from outside the local project. That policies such as these are consistent with a legal definition of majority community ownership was criticized by some respondents. In a similar fashion, Goedkoop and Devine-Wright (p. 142, 2016) found that communities would likely find it "impossible" for local residents "to raise sufficient capital to provide their share of a larger project, this could necessitate opening up share offers to individuals living outside of the local area." The study also describes potential citizen co-investors as "highly educated, middle aged" residents with disposable income, which was a concern echoed by focus group participants interviewed by Lienhoop (2018). Lienhoop (2018) further names "rural residents living in communities with wind energy potential" as likely beneficiaries (p. 101) but highlights German federal regulation in Mecklenburg-Western Pomerania directed towards residents within a 5 km radius of a development.

In contrast, other paper are less specific as to eligibility criteria. Hyland and Bertsch (2018) framed questions by defining "local" Irish communities and residents as those who "may be affected … when new wind farms are developed" (p. 457). Vuichard et

al. (2019) states that community members (from the municipality) could invest, similar to Mostegl et al. (2017) who mention community ownership. Both do not specify further the benefits of that investment for citizen investors. Individuals from the region are one group that could potentially invest in Vuichard et al. (2022) but they give no reference to benefits. Instead, benefit schemes are a separate category from citizen investments. Langer et al. (2017) refer to a wind farm in the neighborhood but do not clearly define who could invest. However, another attribute in the study mentions a distance up to 10 km or even more between the turbines and place of residents.

There are different approaches and timings used among the sample which can be divided mainly in ex ante and ex post. Warren and McFadyen (2010) and Musall and Kuik (2011) compare community energy and developer-led projects by comparative case studies of projects after commission. Walker and Baxter (2017) analyzed several projects in two provinces in Canada, Nova Scotia and Ontario. Leer Jørgensen et al. (2020) conducted focus group interviews with Danish local residents. Brennan et al. (2017) investigated a large project in the Midlands by three developers that aimed at the export of electricity from Ireland to UK which is currently on hold. Goedkoop and Devine-Wright (2016) interviewed UK stakeholders with industry, community and advisory backgrounds. Other studies are ex ante. Mostegl et al. (2017) focus on a Bavarian community in Germany where the municipality aims to build renewable energy. It is a hypothetical project, but the municipality supports the study. Most common ex ante studies are (online) surveys ((Langer et al., 2017), (Hyland and Bertsch, 2018), (Lienhoop, 2018), (Vuichard et al., 2019), (Tanujaya et al., 2020) and (Vuichard et al., 2022)).

4.3. Are there common lessons as to the perceived local acceptability of a citizen investment scheme?

The studies in this review show varying degrees of associations between citizen investment and community acceptance of wind turbines. Warren and McFadyen (2010) and Musall and Kuik (2011) both find that ownership has a positive effect on community acceptance. Mostegl et al. (2017) focus on ‘community ownership’ and ‘external investor’. The former performs significantly better in terms of utility, indicating that there is a strong preference for community-led projects, especially due to household savings accrued as revenue under a community ownership model. These very positive associations are reported by Warren and McFadyen (2010) and Musall

and Kuik (2011) withs statements that citizens felt pride in their respective local wind farms.

Furthermore, these papers emphasize the existence of a strong will and support in the local community and municipality to build wind farms. For example, Mostegl et al. (2017) states that the local council gave a great deal of support to the project, through collaborative planning, consultation and engagement of an interested panel of local citizens. Warren and McFadyen (2010) make similar reports, stating that the community made a "bold initiative by the community to take charge of their own destiny" (p. 207) to counteract socio-economic downturn, job-loss and out-migration (p. 207). Musall and Kuik (2011) refer to an "ambitious energy concept" (p. 3254) that the community initiated after a devastating flood. The authors do not directly refer to fairness, trust and risk but make reference to the planning process by stating that the respondents perceived it as more transparent, despite of not having a "distinct information campaign by the community authority" (p. 3258) (p. 3258). This is not reported for the private ownership case. The authors explain that this positive perception might be due to with the fact that issues were discussed within the community at a local club and foundation. Musall and Kuik (2011) state that the project saw the "reinvestment of the profits to the benefit of the local population" (p. 3259).

Many papers find a conditional relationship between citizen investment and community acceptance. Walker and Baxter (2017) analyzed two provinces in Canada, Nova Scotia and Ontario. The majority of the citizens were in favor of citizen investments, but both proponents and opponents pointed to caveats. The authors found concerns about fair distribution of benefits and that citizens are frequently not aware of the opportunity to invest. Another aspect of concern was that not only local citizens invested into the citizen investment schemes. Some participants expressed that the cases were not grass-roots developments but were "brought to the communities by outside interests" (p. 764).

Brennan et al. (2017) investigated a large project in the Midlands by three developers that aimed at the export of electricity from Ireland to UK. This paper explores various ways in which the considered community would benefit from electricity discounts, community benefit funds, individual compensation and citizen investment. The Midlands project is currently on hold and therefore no specific offer to communities had been made at the time of the study. Both public stakeholders and wind farm operators in the focus group discussions were in principle supportive of shared governance initiatives. However, some residents were skeptical that the developers

would cooperate with them. Nevertheless, local independent developments were not an alternative either as community respondents showed apprehension about high risk and complexity of wind energy projects, as well as the time before financial returns can be realized. Another key issue was that some participants felt it to be unfair that turbines were located in their community without them benefitting from electricity generation.

A lack of trust is also an element discussed by Goedkoop and Devine-Wright (2016). The authors interviewed UK stakeholders with industry, community and advisory backgrounds to investigate how shared ownership was interpreted by these individuals. The authors highlight a lack of trust in the viewpoints of different stakeholders. Developers expressed skepticism about the capabilities and representativeness of community stakeholders, and community stakeholders viewed developers as primarily profit-driven, with a likelihood to instrumentalize communities to gain their approval for planning. Overall, the authors conclude that shared ownership is difficult in practice and that a lack of trust at the project level can undermine cooperation. However, there is some evidence that citizen investment can have a positive effect in this study, in particular when "partnerships are negotiated between developers that express a normative rationale for community engagement and pragmatic community actors that are prepared to accept what developers might offer" (p. 144).

Hyland and Bertsch (2018) compare a community benefit scheme, equity involvement (co-ownership), joint ventures (co-ownership) and energy cooperatives (community ownership). They carried out an experiment among Irish citizens and found that when the depth of involvement increases, the acceptance of citizen investment models decreases. Given that risk tends to increase with greater levels of voting control over the project, Hyland and Bertsch (2018) find that citizens prefer forms of participation with less scope for active involvement However, they still found a 39% increase in acceptance for equity involvement, 36% for joint venture and 38% for a cooperative compared to no opportunity for citizens to financially participate in a wind farm. The authors suspect risk aversion, lack of trust, or perceived unfairness as potential explanations, but did not survey these variables.

Vuichard et al. (2022) distinguish different forms of ownership and distribution of benefits. They distinguish between ownership of individual(s) from the region, local electric utility, cooperation between local electric utility and investor, and a foreign energy company. They showed in a choice experiment among Swiss, Estonian and Ukrainian respondents that citizens from Switzerland and Ukraine have a negative

and from Estonia a positive perception of ownership by individuals(s) from the region of the wind farms. Contrary to this, ownership models by a local electric utility or cooperation including a specialized investor were preferred. The least preferred option was ownership by a foreign energy company. Overall, other attributes relating to the distribution of benefits and governance processes were less important than citizen investment, while ecological and visual impact were the most important attributes of those included. Local ownership therefore had a medium-strong effect on community acceptance.

Lienhoop (2018) explored local public preferences for different forms of financial and procedural participation through a choice experiments and focus groups with German residents living in communities with significant wind energy potential. The study considered a local business tax, compensation payments and co-ownership as mean of how the community can get involved. The authors report that interest in co-ownership was generally low and the perceptions about this form of financial participation were mixed. It is reported that "there was an overall concern that shares are a risky investment and there was no interest to participate in the potential losses of the wind energy project" (p.101) which was associated with the bankruptcy of a prominent national energy developer. Some citizens perceived a community wind farm or a regional developer to be more trustworthy, but "only a minority" were interested in actually participating through shareholding. Among the financial models, the authors report there was some preference for citizen investment opportunities, but it was not very strong.

Langer et al. (2017) consider different forms of participation to examine which form has the greatest potential to increase community acceptance. They found that financial participation has a small positive marginal utility and conclude that "citizens may not have sufficient knowledge about wind energy investments, may be afraid to invest in wind energy projects, or have little or no trust in wind energy companies or operators" (p. 68). Tanujaya et al. (2020) and Vuichard et al. (2019) found only minor effects of citizen investments on community acceptance. Both studies entailed an experimental setting distinguishing between different citizen investment models. They did not further specify how perceived fairness, trust and risk could have influenced the preferences of the respondents.

Tanujaya et al. (2020) conducted an experiment in South Korea with two different populations. The first comprised residents in regions with existing renewable energy projects. The other was made up of a nationally representative sample. The authors

considered bonds and equity models. However, the statistical analysis of the experimental data revealed no significant effect for both citizen investment models.

Vuichard et al. (2019) considered benefits to the community living nearby in general (through taxes of the wind farm) and individuals in this community (through investing in shares or bonds). They conducted a survey and experiment among a representative sample of the Swiss population and found a minor and not significant effect of citizen investment and community acceptance. The respondents were asked to rate how much they accepted the project proposal of the hypothetical wind farm. The proposal consisted of attributes including amongst others the financial participation model, price, duration. In total they considered three different financial participation models, two of them citizen investments (wind share and a wind bond). The authors found that all proposals were rated similarly, despite differences in the type of benefit through various financial participation models. They found minor but no significant increased acceptance for projects through citizen investment for neither of their models.

Leer Jørgensen et al. (2020) is the only paper which comments in detail on reasons for a strong negative association between citizen investment and community acceptance, at least for some of the local population. The authors conducted focus group interviews with Danish local residents and analyzed the perception of property value-loss scheme, co-ownership scheme and the green scheme (community benefit scheme). The authors report that some residents raised concerns about distributive fairness. These residents expressed a sense of injustice and lack of trust in the developer. The claims are based on the criticism that developers were perceived to undertake only minimal efforts to involve residents through co-ownership. Furthermore, some residents stated their investment did not reflect their acceptance of the project, and one participant described their shares as “self insurance” (p.7) against the project.

Many studies report that fairness, trust and risk (or more specifically, citizens’ perceptions of the extent of (or lack of) fairness, trustworthiness and risk) are common themes in the sampled papers when analyzing and interpreting the relationship between citizen investment and community acceptance. Of the sample of this study, only Warren and McFadyen (2010) and Tanujaya et al. (2020) do not explicitly refer to these issues. The combined evidence of nine studies, that factors which negatively influence the relationship between citizen investment and community acceptance include: knowledge about citizen investment and its associated risks (Hyland and Bertsch, 2018; Lienhoop, 2018), lack of trust in the developer (Musall and Kuik, 2011; Goedkoop and Devine-Wright, 2016; Brennan et al., 2017; Hyland and Bertsch, 2018;

Lienhoop, 2018; Leer Jørgensen et al., 2020) and the perception of unfairness in relation to (1) the process (Leer Jørgensen et al., 2020) and (2) the sharing of benefits (and costs) (Lienhoop, 2018).

5. Conclusion

5.1. Overall conclusion

This review notes that many of the conceptions of citizen investment are framed within the context of a just transition and have drawn on policy cases which were early to introduce citizen investment terms within the context of utility-scale wind energy deployment. The heightened policy attention on citizen investment has foregrounded the Danish and German cases, whose adoption of wind energy throughout the 1980s was galvanized by the role of citizen-led wind farm projects (Curtin et al., 2018). The papers reviewed within this paper highlights uncertainty across other cases as to how best to define and structure the eligibility for citizen investment into wind farms. Auction-based approaches aim to deploy renewable energy capacity affordably and at scale and increasingly rely on commercial developers. This presents new questions as to the socioeconomic opportunities and challenges for citizens as actors within local energy transitions. Understanding the emerging mechanisms for citizen investment can help to progress SDGs 7 (renewable energy), 13 (climate action), 9 (innovation and infrastructure) 16 (peace, justice and strong institutions). These principles are important for diversity, representation, and inclusion in further policy formulation towards net zero emissions.

This study offers a review of empirical papers which address the relationship between citizen investment into onshore wind farms and community acceptance. The results demonstrate that the issue of citizen investment is complex, given that the defined eligible 'community' could extend over potentially greater distances than the impacted residents in the vicinity of the project and the varied kind of investment models used.

The issue of investment into a wind farm by citizens living near the project (as well as communities of interest and developers from outside a given geographic area) have implications for the perceived distributional and procedural fairness, and thus on the acceptance of wind energy projects. Furthermore, this research notes that different types of citizen investment models are used in practice and that preferences of citizen investors differ between the analyzed studies. Local acceptance of citizen investment

depends among others on the perceived risks of such investments. Citizen investments that formally structure the power of citizen investors through voting control have higher risks for shareholders, which highlights that there is a trade-off between the level of involvement and financial risk. Citizen investment models are therefore sometimes at odds with the needs of the community and therefore could hinder a positive relationship to community acceptance.

Simply offering citizen investments is likely not a singular instrument for the purpose of increasing acceptance. Studies which state citizen investment to be effective tend to also report a long process of self-empowerment within communities, active support of local politics and experience from past projects. The empirical evidence contrasted within this review illustrates factors such as trust, perceptions of fairness and risks, and experiences related to collective actions could influence the relationship between citizen investment and community acceptance.

5.2. Further research

This study shows that citizen investment into onshore wind farm development is an emerging but not yet well-established practice, which is illustrated by the fact that only 13 papers were suitable for the purpose of this study. The analysis shows the need for more empirical research on citizen investment models, which will become increasingly relevant in the near future due to an increase in policies that aim at promoting them. This study identifies several possibilities for further research.

First, as the papers in the study were all cross-sectional, longitudinal research effort should focus on different stages of the project development process (before and after planning, commissioning, and construction; or ex ante and ex post). Joining others (e.g., see Ferraro and Ellis (2017); Rand and Hoen (2017)), this study proposes that it is highly relevant to investigate how the perceptions of citizen investment models and relating variables change over time. This approach would apply Wolsink (2007)`s U-shaped curve for the dynamic development of attitudes over project lifetime within this new context (Wolsink, 1989; Cousse et al., 2020).

Second, there is some evidence to suggest that citizen investment models with voting rights for citizen control are not implicitly preferred to participation forms with less scope for citizen involvement (e.g., crowdfunding through debt investments and household benefits such as electricity discounts). This is perhaps surprising. In theory, citizen investments could facilitate greater procedural fairness because they give neighboring residents more say in a nearby wind farm. Focusing on why and when a

higher level of participation (e.g., voting control) or more limited opportunities for participation (e.g., benefits and citizen investments without shared control) are desirable to nearby communities is a worthwhile future research topic. Mixed qualitative and quantitative approaches could helpfully contribute to a better understanding of how positive and negative perceptions evolve. This would strengthen theoretical explanations as to the circumstances in which citizen investment models with stronger/weaker scope for citizen involvement, control and voting opportunities are preferred, including the effects of trust, pride and a sense of ownership in projects.

Third, the paper identifies several opportunities to expand the choice of methodologies applied to citizen investments and community acceptance, finding several commonalities which have been investigated so far. Research has been approached through a combination of ex ante forecasting methods such as semi-structured interviews and experiments and ex post investigations including focus groups and community surveys concerning realized citizen investment schemes. Given the relative novelty of citizen investment mechanisms, the identified studies highlight a research gap associated with representative samples for a wider range of wind energy projects. As revealed preference datasets of realized citizen investment schemes become available over time, this topic invites examination.

Fourth, it would be interesting for future research to explore roles of citizen participation in the (co-) ownership of renewables across markets with different political and technological experiences and norms. Citizen involvement in decentralized renewable electricity depends on a country's priorities, capabilities, and preparedness, which are influenced by socio-cultural, technical, political, and economic particularities. This highlights the need for deeper research to further investigate the trade-offs between citizen participation mechanisms across different contexts. Such perspective will contribute to a deeper understanding of the mechanisms through which it is possible to open roles for citizens to participate in, and benefit from, the production of renewable energy. Community involvement in decentralized renewable technologies can be important for the energy transitions across the global south. Lakhanpal (2019) and Zárate-Toledo et al. (2019) suggest that there are distinctions between the reasons for local opposition to wind farms in economies of the global north and the global south, which give greater focus to concerns of land access or displaced livelihoods. The promotion of citizen investment is one mechanism in which stakeholders might be included in the process of energy production. Considering this, the cases presented and analyzed in this review show

that citizen investments opportunities are not a singular instrument for the purpose of increasing participation in local energy developments. Despite the potential contributions towards sustainable development, particularly SDG 16, citizen investment cannot be considered independently of other aspects of integrated decision-making and participation. Within this context, further examination of the ways in which citizen investment mechanisms have been implemented in the context of renewable energy developments in emerging wind markets would be a valuable undertaking for future research.[18]

Fifth, the effects of climate change mean that political pressure to rapidly develop new wind farms will increase in many countries around the world. However, issues related to climate change are just one aspect of the energy policy trilemma that comprises of a) energy security, b) energy cost, and c) environmental outcomes. Climate and energy policies are sometimes at odds. For example, there is an increasing policy focus on promoting community engagement and participation in wind energy projects as conceptualized under policies such as the European Union's Recast Energy Directive. However, the simultaneous increasing adoption of policies like technology-neutral renewable energy auctions that aim to reduce the levelized cost of electricity are in some ways counterproductive to this aim [11, 12]. These auctions make the involvement of communities more challenging. Further research could elaborate how to connect efforts to build community participation in renewable energy production with other policy aims related to the energy transition. The increasing use of natural resources such as wind energy presents complex questions about the decentralization and polycentricity of human-made technologies and the optimal governance, management, and interdependencies between participating actors (Goldthau, 2014). It would be valuable to give specific focus to the interactions which promote or constrain different outcomes for citizen investment and particularly the conditions that determine the flow of information and accordingly potential winners and losers. In this respect, actor-network theory has also been helpfully applied to examine the legitimacy, controversies and participatory dimensions of onshore wind energy (Jolivet and Heiskanen, 2010; Rohe and Chlebna, 2021). Another approach which has been applied to citizen involvement in wind energy is the Socio-Ecological System framework (McGinnis and Ostrom, 2014), for instance to examine the strategic actions

[18] For example, the multi-million-euro Kouga, Tsitsikamma and Cookhouse utility wind farm projects in the Eastern Cape, South Africa, are joint-owned in partnership with local development trusts as a minority shareholder (16-25%).

undertaken by citizen renewable energy cooperatives towards specific policy developments (Bauwens, 2016).

Sixth, the review process drew on a preliminary review and stakeholder inputs from a policy, industry and social research perspective. These inputs helped to inform the search terms, the design of appropriate inclusion/exclusion criteria, and the focus of analysis across multiple databases. Nevertheless, the empirical research papers covering citizen investment opportunities is not mutually comparable (i.e., the data are incomplete and non-systematic in aggregate). These assumptions could be enhanced in future research using policy analysis and thematic coding to define search terms to reduce the possibility of setting-specific sources of error.

Finally, the investigation identifies studies which have a framework for citizen investment. This calls attention to the need for deeper research into other contexts where citizen investment takes place but which, for various reasons, are either not mentioned within the identified papers or whose scope does not meet the selection criteria of this study. Future research could also build on this research by giving specific focus to the additional cases. For such an endeavor, it may be necessary lessening the specificity of the search criteria to include empirical studies which do not explicitly consider the acceptance of a wind farm by the community living in the immediate vicinity would be one approach to identifying alternative policy mechanisms.

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Appendix

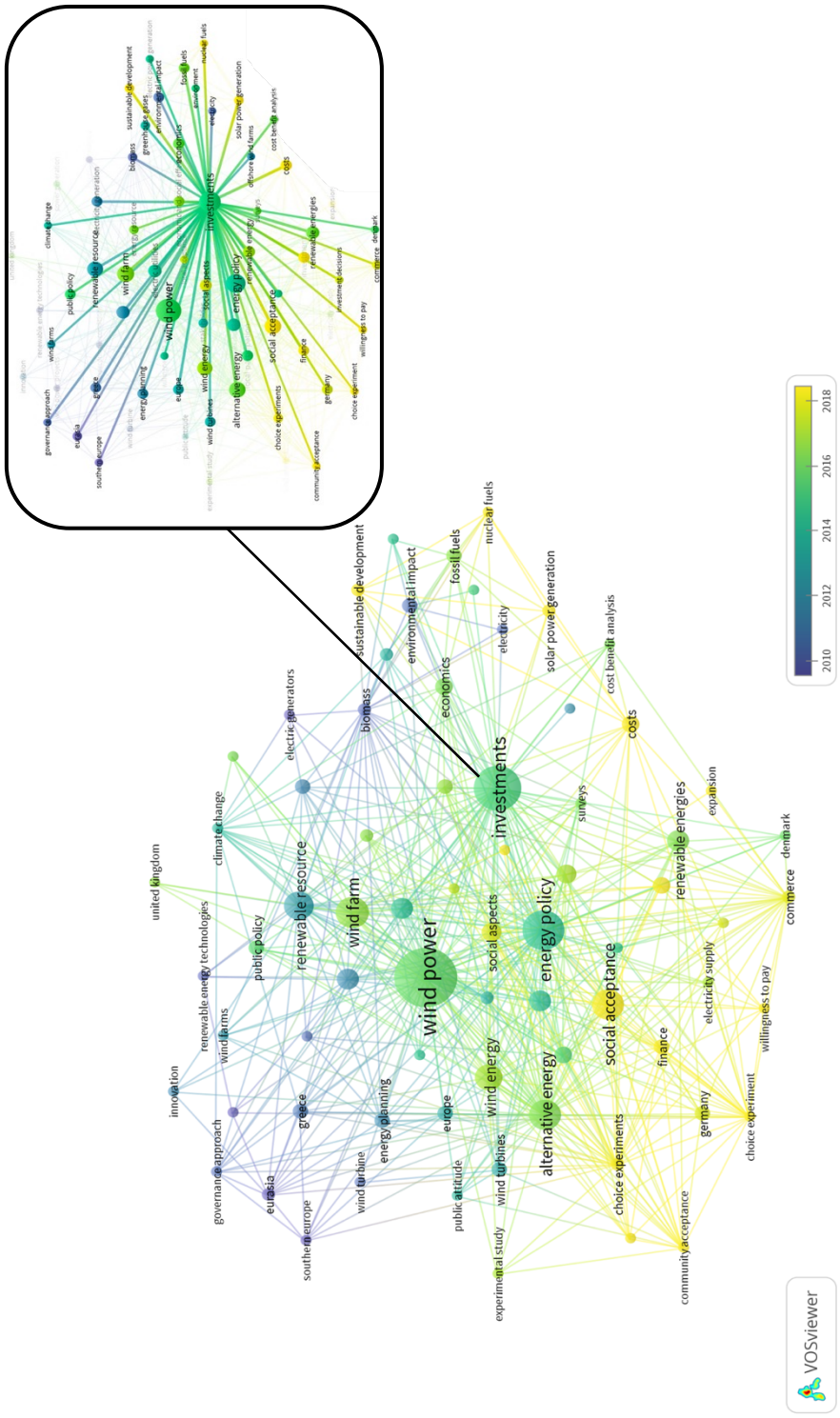

Figure A.1: Co-occurrence of 71 terms grouped into 5 clusters identified from 142 papers. Average publication year is shown on a scale blue - yellow, up to June 2022. Weight scales of bibliographic data nodes are based on occurrence by binary counts of author-supplied and indexing keywords and titles, and normalized for association strength, showing 500 links of co-occurrence between terms. Box shows links to "investments" term.

References

Aitken, M., 2010. Wind power and community benefits: Challenges and opportunities. Energy Policy 38, 6066-6075.

Baker, L., Hook, A., Sovacool, B.K., 2021. Power struggles: Governing renewable electricity in a time of technological disruption. Geoforum 118, 93-105.

Bauwens, T., 2016. Explaining the diversity of motivations behind community renewable energy. Energy Policy 93, 278-290.

Bauwens, T., Devine-Wright, P., 2018. Positive energies? An empirical study of community energy participation and attitudes to renewable energy. Energy Policy 118, 612-625.

Baxter, J., Walker, C., Ellis, G., Devine-Wright, P., Adams, M., Fullerton, R.S., 2020. Scale, history and justice in community wind energy: An empirical review. Energy Res. Soc. Sci. 68.

Brennan, N., Van Rensburg, T.M., 2016. Wind farm externalities and public preferences for community consultation in Ireland: A discrete choice experiments approach. Energy Policy 94, 355-365.

Brennan, N., van Rensburg, T.M., 2020. Public preferences for wind farms involving electricity trade and citizen engagement in Ireland. Energy Policy 147.

Brennan, N., Van Rensburg, T.M., Morris, C., 2017. Public acceptance of large-scale wind energy generation for export from Ireland to the UK: evidence from Ireland. Journal of Environmental Planning and Management 60, 1967-1992.

Bristow, G., Cowell, R., Munday, M., 2012. Windfalls for whom? The evolving notion of 'community' in community benefit provisions from wind farms. Geoforum 43, 1108-1120.

Côté, E., Đukan, M., Pons-Seres de Brauwer, C., Wüstenhagen, R., 2022. The price of actor diversity: Measuring project developers' willingness to accept risks in renewable energy auctions. Energy Policy 163.

Cousse, J., Wüstenhagen, R., Schneider, N., 2020. Mixed feelings on wind energy: Affective imagery and local concern driving social acceptance in Switzerland. Energy Res. Soc. Sci. 70.

Cowell, R., Bristow, G., Munday, M., 2011. Acceptance, acceptability and environmental justice: the role of community benefits in wind energy development. Journal of Environmental Planning and Management 54, 539-557.

Curtin, J., McInerney, C., Gallachóir, B.Ó., Salm, S., 2019. Energizing local communities—What motivates Irish citizens to invest in distributed renewables? Energy Res. Soc. Sci. 48, 177-188.

Curtin, J., McInerney, C., Johannsdottir, L., 2018. How can financial incentives promote local ownership of onshore wind and solar projects? Case study evidence from Germany, Denmark, the UK and Ontario. Local Economy: The Journal of the Local Economy Policy Unit 33, 40-62.

Curtin, J., McInerney, C., Ó Gallachóir, B., 2017. Financial incentives to mobilise local citizens as investors in low-carbon technologies: A systematic literature review. Renewable and Sustainable Energy Reviews 75, 534-547.

Department of Energy Nova Scotia, 2010. Renewable Electricity Plan, Halifax.

Devine-Wright, P., Sherry-Brennan, F., 2019. Where do you draw the line? Legitimacy and fairness in constructing community benefit fund boundaries for energy infrastructure projects. Energy Res. Soc. Sci. 54, 166-175.

Dimitropoulos, A., Kontoleon, A., 2009. Assessing the determinants of local acceptability of wind-farm investment: A choice experiment in the Greek Aegean Islands. Energy Policy 37, 1842-1854.

Đukan, M., Kitzing, L., 2021. The impact of auctions on financing conditions and cost of capital for wind energy projects. Energy Policy 152.

European Parliament and Council of Europe, 2018. Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the Promotion of the Use of Energy from Renewable Sources (Text with EEA Relevance).

Fast, S., Mabee, W., Baxter, J., Christidis, T., Driver, L., Hill, S., McMurtry, J.J., Tomkow, M., 2016. Lessons learned from Ontario wind energy disputes. Nature Energy 1.

Ferraro, G., Ellis, G., 2017. The social acceptance of wind energy.

García, J.H., Cherry, T.L., Kallbekken, S., Torvanger, A., 2016. Willingness to accept local wind energy development: Does the compensation mechanism matter? Energy Policy 99, 165-173.

Gjørtler Elkjær, L., Horst, M., Nyborg, S., 2021. Identities, innovation, and governance: A systematic review of co-creation in wind energy transitions. Energy Res. Soc. Sci. 71.

Goedkoop, F., Devine-Wright, P., 2016. Partnership or placation? The role of trust and justice in the shared ownership of renewable energy projects. Energy Res. Soc. Sci. 17, 135-146.

Goldthau, A., 2014. Rethinking the governance of energy infrastructure: Scale, decentralization and polycentrism. Energy Res. Soc. Sci. 1, 134-140.

Grashof, K., 2019. Are auctions likely to deter community wind projects? And would this be problematic? Energy Policy 125, 20-32.

Haggett, C., Aitken, M., 2015. Grassroots Energy Innovations: the Role of Community Ownership and Investment. Current Sustainable/Renewable Energy Reports 2, 98-104.

Haggett, C., Aitken, M., Rudolph, D., van Veelen, B., Harnmeijer, J., Markantoni, M., 2014. Supporting Community Investment in Commercial Renewable Energy Schemes.

Hall, N.L., 2014. Can the "Social Licence to Operate" Concept Enhance Engagement and Increase Acceptance of Renewable Energy? A Case Study of Wind Farms in Australia. Social Epistemology 28, 219-238.

Hall, N.L., Hicks, J., Lane, T., Wood, E., 2019. Planning to engage the community on renewables: insights from community engagement plans of the Australian wind industry. Australasian Journal of Environmental Management 27, 123-136.

Hinshelwood, E., 2001. Power to the People: community-led wind energy - obstacles and opportunities in a South Wales Valley. Community Development Journal 36, 96-110.

Hockerts, K., Wüstenhagen, R., 2010. Greening Goliaths versus emerging Davids — Theorizing about the role of incumbents and new entrants in sustainable entrepreneurship. Journal of Business Venturing 25, 481-492.

Holstenkamp, L., 2014. Local investment schemes for renewable energy: A financial perspective, Renewable Energy Law in the EU, pp. 232-255.

Hyland, M., Bertsch, V., 2018. The Role of Community Involvement Mechanisms in Reducing Resistance to Energy Infrastructure Development. Ecological Economics 146, 447-474.

Intergovernmental Panel on Climate Change, 2022. Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, in: H.-O. Pörtner, D.C.R., M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (Ed.).

International Renewable Energy Agency, 2020. Innovation landscape brief: Community-ownership models. International Renewable Energy Agency, Abu Dhabi.

International Renewable Energy Agency, International Energy Agency, REN21, 2018. Renewable Energy Policies in a Time of Transition.

Jolivet, E., Heiskanen, E., 2010. Blowing against the wind—An exploratory application of actor network theory to the analysis of local controversies and participation processes in wind energy. Energy Policy 38, 6746-6754.

Jørgensen, B.H., Holttinen, H., International Energy Agency Wind Operating Agents, International Energy Agency Wind Secretariat, 2021. IEA Wind TCP Annual Report 2020.

Kerr, S., Johnson, K., Weir, S., 2017. Understanding community benefit payments from renewable energy development. Energy Policy 105, 202-211.

Knauf, J., 2022. Can't buy me acceptance? Financial benefits for wind energy projects in Germany. Energy Policy 165.

Knauf, J., Wüstenhagen, R., 2023. Crowdsourcing social acceptance: Why, when and how project developers offer citizens to co-invest in wind power. Energy Policy 173.

Koirala, B.P., Koliou, E., Friege, J., Hakvoort, R.A., Herder, P.M., 2016. Energetic communities for community energy: A review of key issues and trends shaping integrated community energy systems. Renewable and Sustainable Energy Reviews 56, 722-744.

Krueger, A.D., Parsons, G.R., Firestone, J., 2011. Valuing the Visual Disamenity of Offshore Wind Power Projects at Varying Distances from the Shore: An Application on the Delaware Shoreline. Land Economics 87, 268-283.

Krug, M., Di Nucci, M.R., 2020. Citizens at the heart of the energy transition in Europe? Opportunities and challenges for community wind farms in six European countries. Renewable Energy Law and Policy Review 9, 9-27.

Lakhanpal, S., 2019. Contesting renewable energy in the global south: A case-study of local opposition to a wind power project in the Western Ghats of India. Environmental Development 30, 51-60.

Langer, K., Decker, T., Menrad, K., 2017. Public participation in wind energy projects located in Germany: Which form of participation is the key to acceptance? Renewable Energy 112, 63-73.

Leer Jørgensen, M., Anker, H.T., Lassen, J., 2020. Distributive fairness and local acceptance of wind turbines: The role of compensation schemes. Energy Policy 138.

Lienhoop, N., 2018. Acceptance of wind energy and the role of financial and procedural participation: An investigation with focus groups and choice experiments. Energy Policy 118, 97-105.

Lowitzsch, J., 2020. Investing in a renewable future – renewable energy communities, consumer (co-)ownership and energy sharing in the clean energy package. European Energy & Climate Journal 9, 45-70.

Lowitzsch, J., Hoicka, C.E., van Tulder, F.J., 2020. Renewable energy communities under the 2019 European Clean Energy Package – Governance model for the energy clusters of the future? Renewable and Sustainable Energy Reviews 122.

McGinnis, M.D., Ostrom, E., 2014. Social-ecological system framework: initial changes and continuing challenges. Ecology and Society 19.

McInerney, C., Curtin, J., 2017. Financial incentives to promote citizen investment in low-carbon and resource-efficient assets.

Mergner, R., Rutz, D., 2014. Community energy in Germany: existing models, public-private funding and good practice examples, Report for CO-POWER project, Munich.

Mey, F., Hicks, J., 2019. Community Owned Renewable Energy: Enabling the Transition Towards Renewable Energy?, Decarbonising the Built Environment, pp. 65-82.

Morris, C., 2019. Community energy in Germany. Agentur für Erneuerbare Energien.

Mostegl, N.M., Pröbstl-Haider, U., Haider, W., 2017. Spatial energy planning in Germany: Between high ambitions and communal hesitations. Landscape and Urban Planning 167, 451-462.

Mumford, J., Gray, D., 2010. Consumer engagement in alternative energy—Can the regulators and suppliers be trusted? Energy Policy 38, 2664-2671.

Musall, F.D., Kuik, O., 2011. Local acceptance of renewable energy—A case study from southeast Germany. Energy Policy 39, 3252-3260.

Page, M.J., McKenzie, J.E., Bossuyt, P.M., Boutron, I., Hoffmann, T.C., Mulrow, C.D., Shamseer, L., Tetzlaff, J.M., Akl, E.A., Brennan, S.E., Chou, R., Glanville, J., Grimshaw, J.M., Hrobjartsson, A., Lalu, M.M., Li, T., Loder, E.W., Mayo-Wilson, E., McDonald, S., McGuinness, L.A., Stewart, L.A., Thomas, J., Tricco, A.C., Welch, V.A., Whiting, P., Moher, D., 2021. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. Syst Rev 10, 89.

Petticrew, M., Roberts, H., 2006. Systematic Reviews in the Social Sciences.

Rand, J., Hoen, B., 2017. Thirty years of North American wind energy acceptance research: What have we learned? Energy Res. Soc. Sci. 29, 135-148.

Regen, S.W., 2014. Community Benefits from Onshore Wind Developments: Best Practice Guidance for England. Department of Energy and Climate Change.

Roberts, J., Bodman, F., Rybski, R., 2014. Community Power: Model Legal Frameworks for Citizen-owned Renewable Energy. ClientEarth, London.

Rohe, S., Chlebna, C., 2021. A spatial perspective on the legitimacy of a technological innovation system: Regional differences in onshore wind energy. Energy Policy 151.

Rønne, A., Gerhardt Nielsen, F., 2019. Consumer (Co-)Ownership in Renewables in Denmark, Energy Transition, pp. 223-244.

Rossi, M., 2014. The New Ways to Raise Capital: An Exploratory Study of Crowdfunding. International Journal of Financial Research 5.

Schroeter, R., Scheel, O., Renn, O., Schweizer, P.-J., 2016. Testing the value of public participation in Germany: Theory, operationalization and a case study on the evaluation of participation. Energy Res. Soc. Sci. 13, 116-125.

Shared Ownership Task Force, 2014. Report to DECC.

Simcock, N., 2013. Exploring how stakeholders in two community wind projects use a "those affected" principle to evaluate the fairness of each project's spatial boundary. Local Environment 19, 241-258.

Slee, B., 2015. Is there a case for community-based equity participation in Scottish on-shore wind energy production? Gaps in evidence and research needs. Renewable and Sustainable Energy Reviews 41, 540-549.

Solman, H., Smits, M., van Vliet, B., Bush, S., 2021. Co-production in the wind energy sector: A systematic literature review of public engagement beyond invited stakeholder participation. Energy Res. Soc. Sci. 72.

Strachan, P.A., Cowell, R., Ellis, G., Sherry-Brennan, F., Toke, D., 2015. Promoting Community Renewable Energy in a Corporate Energy World. Sustainable Development, n/a-n/a.

Strazzera, E., Mura, M., Contu, D., 2012. Combining choice experiments with psychometric scales to assess the social acceptability of wind energy projects: A latent class approach. Energy Policy 48, 334-347.

Tanujaya, R.R., Lee, C.-Y., Woo, J., Huh, S.-Y., Lee, M.-K., 2020. Quantifying Public Preferences for Community-Based Renewable Energy Projects in South Korea. Energies 13.

The Scottish Government, 2019. Scottish Government Good Practice Principles for Shared Ownership of Onshore Renewable Energy Developments.

van Veelen, B., 2016. Making Sense of the Scottish Community Energy Sector – An Organising Typology. Scottish Geographical Journal 133, 1-20.

von Wirth, T., Gislason, L., Seidl, R., 2018. Distributed energy systems on a neighborhood scale: Reviewing drivers of and barriers to social acceptance. Renewable and Sustainable Energy Reviews 82, 2618-2628.

Vuichard, P., Broughel, A., Wüstenhagen, R., Tabi, A., Knauf, J., 2022. Keep it local and bird-friendly: Exploring the social acceptance of wind energy in Switzerland, Estonia, and Ukraine. Energy Res. Soc. Sci. 88.

Vuichard, P., Stauch, A., Dällenbach, N., 2019. Individual or collective? Community investment, local taxes, and the social acceptance of wind energy in Switzerland. Energy Res. Soc. Sci. 58.

Wahlund, M., Palm, J., 2022. The role of energy democracy and energy citizenship for participatory energy transitions: A comprehensive review. Energy Res. Soc. Sci. 87.

Walker, C., Baxter, J., 2017. "It's easy to throw rocks at a corporation": wind energy development and distributive justice in Canada. Journal of Environmental Policy & Planning 19, 754-768.

Walker, G., Devine-Wright, P., 2008. Community renewable energy: What should it mean? Energy Policy 36, 497-500.

Warren, C.R., McFadyen, M., 2010. Does community ownership affect public attitudes to wind energy? A case study from south-west Scotland. Land Use Policy 27, 204-213.

Wind Europe, 2021. Financing and investment trends. The European wind industry in 2020, in: Rory O'Sullivan (Ed.).

Wokuri, P., Yalçın-Riollet, M., Gauthier, C., 2019. Consumer (Co-)Ownership in Renewables in France, Energy Transition, pp. 245-270.

Wolsink, M., 1989. Attitudes and expectancies about wind turbines and wind farms. Wind Engineering 13, 196-206.

Wolsink, M., 2007. Wind power implementation: The nature of public attitudes: Equity and fairness instead of 'backyard motives'. Renewable and Sustainable Energy Reviews 11, 1188-1207.

World Economic Forum, 2020. Fostering Effective Energy Transition, Cologny/Geneva ,Switzerland.

Wüstenhagen, R., Wolsink, M., Bürer, M.J., 2007. Social acceptance of renewable energy innovation: An introduction to the concept. Energy Policy 35, 2683-2691.

Yildiz, Ö., Gotchev, B., Holstenkamp, L., Müller, J.R., Radtke, J., Welle, L., 2019. Consumer (Co-)Ownership in Renewables in Germany, Energy Transition, pp. 271-293.

Zárate-Toledo, E., Patiño, R., Fraga, J., 2019. Justice, social exclusion and indigenous opposition: A case study of wind energy development on the Isthmus of Tehuantepec, Mexico. Energy Res. Soc. Sci. 54, 1-11.

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09/2012 – 07/2013	**National Taiwan University, Taiwan** Study abroad, focus on chemical engineering and bioenergy
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Professional Experience

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