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Epistemic justice impossible? Expert perceptions of the participatory monitoring of geo-energy projects in Poland

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ABSTRACT

Achieving energy democracy requires public engagement and social inclusion in decision-making, but meaningful conversations between different groups are essential. In this study, we explore the possibility for such conversations through participatory monitoring practices around energy technology, using geoengineering projects as an example. Despite being central to the attention of local communities, these projects can be conceptually distant and inaccessible because of their subsurface location. This presents a challenge for engaging experts with non-experts. We elaborate the emerging concept of epistemic justice (defined as fair treatment and equal access to knowledge for all stakeholders) and especially one of its dimensions: hermeneutical justice (that emphasizes the need for institutions to respond to the voices of all stakeholders without any prejudices), as preconditions for democratizing energy production. By applying Q-methodology we analyze the attitudes of 22 experts from Poland toward non-experts' participation in common monitoring activities around geo-engineering projects. We identify three types of narratives: "pro-expert", "pro-partnership", and "pro-informative" and argue that experts may be uncertain about their responsibility to engage non-experts in energy projects. Through this study, we encourage experts and knowledge producers to reflect critically on their responsibility to engage non-experts in energy projects and implement democratic procedures more efficiently, including future participatory procedures, thus paving the way for energy democracy to thrive.

1. Introduction

Scholars in social and political sciences have been exploring the concept and practice of energy democracy for several years. Energy democracy has been described as a process, an expected outcome of decarbonization, and a normative goal [1]. The concept implicitly and explicitly refers to various types of justice, which are seen as both preconditions and effects of its achievement. However, the unclear relationship between energy democracy and energy justice has been criticized, especially for using these terms interchangeably [2]. For example, Droubi et al. [2] challenge the assumption that energy democracy contributes to justice [3], arguing that "democratic principles alone are insufficient to deliver the ideal world that the concept promotes" [2] (p. 2).

Inspired by this criticism, we aim to contribute to the ongoing discussion on the relationship between energy democracy and justice by exploring the role of epistemic justice, ensuring fair treatment and equal access to knowledge, understanding, and explanations for all stakeholders, in democratizing the implementation of highly specialized energy technology projects [4]. Specifically, we focus on the participation of the lay public in geo-energy projects, following Droubi et al.'s claim that "in essence, energy democracy is – as democracy is – about (the right to) participation." [2] (p. 4). Our central goal is to understand what the conditions (of possibility) for non-expert participation are by examining experts' openness to it and conceptualizing these conditions in terms of the hermeneutical aspect of epistemic justice [4]. Hermeneutical justice recognizes that people from diverse backgrounds and experiences may bring unique insights and understandings to a situation and that these perspectives should be given equal consideration and respect in the decision-making process [4]. The goal of hermeneutical justice is to ensure that all voices are heard and that decisions are made in a way that is fair, just, and responsive to the needs and concerns of all stakeholders. To get more indepth views on this topic, we perform a Q-methodology study to draw different models and scenarios of experts'

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openness for non-experts participation.

Our contribution to the discussion of energy democracy is quite modest in scope as we are not attempting to solve the broader problem of the democracy-justice relationship or offering a new conceptualization of the energy democracy [5,6]. Rather, we view the concept of epistemic justice as touching upon the essence of democratic participation: the possibility for it and the extent of its fulfillment. Our guiding research questions are: How to engage stakeholders if technological knowledge is not accessible and available to everyone? Why engage non-experts in highly specialized technological projects if the experts do not value lay knowledge in their work? Who should be responsible for ensuring the inclusion of non-experts in technological development?

In other words, our research is centered around identifying the conditions that enable meaningful communication between participants from both expert and non-expert backgrounds. Quality of participation has not only concerned academics but also, in a broader sense, public intellectuals who worry that Western democracies are threatened by a loss of ability and willingness to communicate across different social groups. By exploring this topic, we hope to shed light on how we can improve the quality of participation in public decision-making processes and strengthen democratic ideals.

Democracy in the Western context is suffering today not because people cherish different values – politics has always been about struggles over values [7] - but rather the difficulties of establishing common epistemologies, which have recently been highlighted by controversies over nuclear energy, renewable energy sources, or, still relevant but belonging to the area of public health, the problem of COVID-19 vaccination. Our goal is more modest than aspiring to address or find remedies for the epistemological divides that are tearing contemporary democratic systems apart. Instead, our work is an attempt to address the epistemic dimension of the challenges of democratic participation visible in the context of energy systems [8,9].

Public engagement methodologies and toolkits tend to encourage the exploration of social and cultural contexts in which participation is planned to take place, but they usually prioritize the non-expert side of the process. Thus, these approaches typically prescribe examining local communities' values [10], non-experts' motivations [11], or regional and local conflicts [12,13] before organizing participatory processes concerning various issues or projects. According to these perspectives, all this should be done to ensure more effective engagement. Based on a review of the public engagement guidebooks and manuals [14–16], we have concluded that there is an absence of tools and methods for understanding the expert side of the process. Our study addresses this gap by examining experts and their positions and attitudes toward public participation in projects developed within their field of expertise. Through this research, we aim to contribute to the exploration of the conditions that make epistemic justice possible in participatory practices around energy technology projects, specifically in participatory monitoring (PM).

We define PM as "a process where concerned citizens, government agencies, industry, academia, community groups, and local institutions collaborate to monitor, track, and respond to common community (environmental) concerns" [15] (p. 410). PM is often perceived as being particularly suitable for energy research and energy infrastructure projects, mainly due to the carefully crafted planning and policy responses required by the complexity of the latter [10,17]. However, the interest in and the understanding of PM as a planning strategy for energy projects varies across different institutional and local contexts, depending on factors such as social trust, local cultures of participation, and the culture of expertise [18], which we took into account when designing the research tool and included in the discussion of our results. Participation in environmental monitoring is a new practice that the European Commission has called for in its most recent Horizon Europe research and innovation program [19]. Although PM is sometimes seen as controversial by experts, businesses, and public institutions, its possible implementation may demand a change in attitude. Therefore, we argue that understanding the context within which PM will be used should be a priority before its implementation in specific infrastructure projects.

This article is structured as follows. Section 1 provides an overview of PM and recent developments related to environmental democracy and energy justice that are shaping the use of public engagement methods. Section 2 outlines our methods for data collection and analysis. In Section 3, we present the empirical results of our study. Section 4 offers a discussion of our findings with a comparison to previous studies. Finally, in Section 5, we conclude the paper by discussing the policy implications of our research and considering the limitations of our study.

1.1. *Epistemic justice and participatory monitoring in geo-energy projects*

In political theory, epistemic justice has become associated with the liberal political ideal of freedom as it is considered a central condition for the latter [20]. Miranda Fricker's 2013 essay argued that if "non-domination is best understood as a thoroughly generic liberal ideal of freedom," then "non-domination requires that the citizen can contest interferences" [20] (p. 1317). However, the participation of non-experts in energy technology projects is not only about their ability to contest such projects, though this is certainly one of the important aspects. It is also about their ability to exchange the knowledge needed to assess the impacts of energy technologies on their lives and neighborhoods. Therefore, non-domination has a strong epistemic dimension regarding energy projects, and we argue that it is primarily about the non-domination of expert over non-expert types of epistemologies. Non-domination is thus seen here as the ability of non-experts to contribute their knowledge to the development of energy projects, for example, by sharing their knowledge about local ecosystems and the institutional capacity to include this knowledge in decision-making and operational processes.

PM [21] has recently been proposed as a tool for facilitating knowledge exchange about geo-energy projects. PM is often described as a community-based monitoring or community science tool [22,23], positioned between citizen science and public participation, with the potential to enable more constructive and targeted citizen interventions in technological projects. As citizen science seeks to involve non-expert members of society in research, it can promote epistemic justice by providing opportunities for individuals and communities that traditionally were excluded from the decision-making process or scientific research to become involved [24].

Following Fricker's [20] reasoning on epistemic justice, contestation, which manifests the freedom of citizens, should not only occur within conditions that protect against not getting a "proper hearing" but also against "an unjust deflation of either credibility or intelligibility" (p. 1317). PM, with its position between public participation and citizen science, strongly relies on intelligibility among the communicating actors and the acknowledgment of the credibility of the speakers on both sides—experts and non-experts. Fricker [20] identified two subbranches of epistemic justice: testimonial injustice and hermeneutical injustice. While the former occurs when a "speaker receives a deficit of credibility owing to the operation of prejudice in the hearer's judgment", hermeneutical injustice "occurs at a stage prior to communicative activity, though it will only surface in a certain kind of failed or semi-failed attempt to render an experience intelligible, either to oneself or communicatively to another" [20] (p. 1319).

Similarly, Schwanen [25] discusses dimensions of social justice in the transition of transportation systems and also divides epistemic justice into two components: "the ability of affected constituencies to be heard and to offer their insights on whatever is at stake (testimonial justice), and the capacity of institutionalized knowledge-creation processes to adopt and respond appropriately to those insights (hermeneutical justice)" (p. 685). By emphasizing the capacity to adopt and appropriately respond to various kinds of testimonies in an institutionalized manner as being an important aspect of hermeneutical justice, Schwanen highlights the challenges that institutional boundaries pose to

its fulfillment. In this reading, hermeneutical justice may be most difficult to implement across various institutional boundaries, i.e., across public administration institutions, institutionalized forms of knowledge production, and non-institutionalized modes of knowledge articulation, i.e., as community or individual experience.

Moreover, Schwanen [25] sees the need to complement other types of social justice—distribution, procedure, and recognition—by giving "due regard for epistemic justice in research and governance" (p. 687). This draws our attention not only to policymakers, public administration, or businesses but also to researchers as actors who should "not assume a priori that their understanding of the capabilities, behaviors, interests, and values of individuals and constituencies affected by those transitions are robust and sufficiently sensitive to time, place and social position" (p. 687). In other words, Schwanen calls directly upon researchers from various disciplines to be aware of the situatedness of their own knowledge and not to valorize scientific knowledge over other types of knowledge produced by non-experts. According to Schwanen [25], hermeneutical justice demands the development of responsible and non-exploitative approaches for examining, articulating, and mobilizing non-expert knowledge.

Following up on the points raised above, the participation of non-experts in specialized geo-energy projects involves the risk of experts dominating those who do not share their status. Participation, including specialized forms like PM, involves substantial risks of epistemic injustices. These include both testimonial injustices, when speakers may struggle to formulate their statements, and hermeneutical injustices, when either side lacks the skills or willingness to comprehend the messages being exchanged. In discussions about geo-energy projects, however, lay participants more frequently experience hermeneutical injustice as they are often seen as lacking the same level of education and training as the experts.

Our approach in this paper is to diagnose whether the context of a particular case of participatory activity is conducive for hermeneutical injustice to occur in interaction and, if not, to identify potential scenarios of hermeneutical injustice which could appear between experts' and non-experts in participatory processes. At the same time, we propose a tool that can help diagnose the context for the occurrence of hermeneutical justice in interaction without necessarily having to examine the structural and institutional barriers. In other words, instead of studying the educational, institutional, or class background of non-experts, we suggest studying the attitudes of selected experts toward non-experts' participation in projects in their area of expertise. In this way, we object to reading only the testimonial justice as occurring in interaction, which is contingent on both the situation and the subjective perceptions of the involved participant. Similarly, we argue that hermeneutical justice, especially in Fricker's [20] reading, should not be seen as solely an objective attribute of certain groups of social actors that can be derived from their position within broader social structures of knowledge production and circulation.

According to Fricker [20], testimonial justice could be achieved through some form of "unbiased listening" and hermeneutical justice can be achieved through education. However, these ideas go against the main principles of public participation of non-experts in technological projects, which explicitly aims to overcome the "knowledge deficit" model of interaction [26,27]. Participation is the idea of establishing meaningful conversations between actors where both the testimonial and hermeneutic justice are possible to occur despite their testimonial and hermeneutical skills being different. The idea of participation and citizen science shifts the focus from the structural conditions of possibility for hermeneutical justice to occur toward situational ones. Therefore, while we acknowledge that structural factors cannot be disregarded in participatory interactions, we propose examining the experts' prior perspectives on participation and other related ideals to reconstruct the foundation for hermeneutical justice as the experts' openness for non-experts' involvement in energy projects. Our proposition takes the form of a Q-methodology tool.

We began developing our Q-methodology tool from an observation that experts, business people, or public institution officials tend to generate various stories about non-experts and their engagement in technological projects. These stories convey positive and negative points about the participation process, established relations, difficult or smooth cases of cooperation, humorous anecdotes about misunderstandings, awkward wording used by non-experts, and their informed or uninformed ways of posing questions [28]. These stories often create various preconceptions and imagined characteristics of the involved public before actual participation, leaving lay participants with the option of either accepting experts' knowledge, i.e. about risks, as superior to their own or challenging their expertise at the risk of being perceived as emotional or even irrational [28–30]. Importantly for our argument, these stories set the scene and construct the context for actual practices of public participation. Therefore, we argue that they should be studied to better understand the context in which public engagement is organized and, thus, to realistically assess the possibility of epistemic justice occurring.

1.2. Analytical framework

Our conceptual framework is grounded in narrative theory and the concept of reception [31,32]. Narrations and narratives are a key part of human communication. Narrations are the verbal descriptions that individuals use to relay their lived experiences (i.e., a subjectively constructed reality of "what happened?") and imagined realities (i.e., a subjectively constructed imagination of "what would happen if?"). Narratives are cultural artifacts that are constantly being constructed in interactions while at the same time being an emerging cultural product that is created, transmitted, and transformed through individual narrating activities [31]. Both narrations and narratives serve the function of expressing our visions and perceptions of the surroundings but can also influence listeners in the individual's social environment, e.g., they can build legitimacy for certain framings [33] and co-determine policy responses [34]. Thus, narrations and narratives can be tools for gaining power and dominance, e.g., in transition processes [35].

In this way, narratives and narrations shape the context for action, including whether to apply, not apply, or apply PM in a particular way. To understand the context of these interactions, we have applied the concept of reception, which has a broad meaning and is used to clarify how people understand various phenomena, such as how different audiences understand the same text [36]. Reception studies are deeply rooted in media and art research [32,37] and seek to answer questions like "what kinds of meanings does a given text have? From whom? In what circumstances? With what changes over time? And do these meanings have any effects? Cognitive? Emotional? Social? Political?" [32] (p. 2).

For our research, we assess individual experts' narrations about the participation of the lay public in environmental monitoring to identify co-produced narratives that shape conditions for epistemic justice and the general reception of PM. We believe that our approach contributes to research on the gaps and limitations of inclusive energy democracies [38,39] and challenges to the fulfillment of epistemic justice [25], which are crucial for the facilitation of participation, citizen science, and science communication as well as gaining local knowledge [40] and effective project enhancement [41,42].

2. Methods and data

2.1. Background of Q-methodology

Q-methodology is a mixed qualitative and quantitative method applied in social science research that provides a reproducible measurement of individuals' self-referential, holistic viewpoints [43,44]. This method involves participants sorting a set of purposefully selected statements along a continuum from disagreement to agreement to

assemble their viewpoints on a topic. Each participant's unique sorting represents their viewpoints which we call individual narration, and these sortings are then correlated to identify patterns of shared meanings, which represent narratives in our study [45]. A Q-study consists of six distinct steps (Fig. 1): (1) identification of the concourse, (2) selection of statements (Q-sample), (3) selection of participants (P-set), (4) sorting of statements (Q-sort), (5) factor analysis, and (6) factor interpretation. Detailed description [46] of each step for our study is presented in Sections 2.1.1 to 2.1.6.

2.1.1. Identification of the concourse

The concourse is a comprehensive collection of statements on the investigated topic obtained from various sources (e.g., press, scientific literature, interviews, workshops, etc.). In this case, the concourse is defined by the research aim, which is to identify and characterize experts' narratives on PM in order to depict the context for epistemic justice in monitoring geo-energy projects, their domains of conflict and consensus, and the implications of this for further geo-energy projects.

The concourse in our study was developed through two sources, (1) a project workshop and (2) an extensive review of the scientific literature. The workshop, titled "Towards tailor-made participatory monitoring programs," was organized by the SECURe (Subsurface Evaluation of CCS and Unconventional Risks) [47] project team in The Hague (Netherlands) in March 2019 and attended by geology specialists and social scientists. The primary objective of this workshop was to introduce the framework for PM and provide accompanying guidance on its implementation in actual monitoring activities. Prior to practical activities and group work on real cases, project participants—mostly geology experts—discussed the fundamental factors, opportunities, and barriers they perceive in PM. After the workshop, there was a feedback session with a short debriefing from all participants. The diversity of participants and their open discussions on the topic (before and after work on case studies) were helpful in selecting statements for the Q-methodology study.

We used transcripts from the workshop to build an initial concourse. For the literature search, we used the Scopus database of journals with the following search string: "engagement" AND "shale" OR "ccs"; "participatory monitoring" AND "shale" OR "ccs". The search returned 128 articles published between 1975 and 2020. We then selected 27 articles relevant to the investigated topic. During the methodological discussion sessions of three co-authors of this article, we reviewed the collected text passages where experts expressed their opinions on PM and decision-making processes. We derived the concourse of 48 statements from these text passages after removing clear repetitions.

2.1.2. Selection of statements: Q-sample

A Q-sample is a set of statements selected from the concourse. The selected statements should be balanced and representative of the diversity in the concourse. In this study, we followed the approach described by Díaz et al. [48] for the statement selection, which is to define categories and assign the statements accordingly. This cluster of statements enabled us to delete or merge similar statements or turn very detailed statements into more general ones. A final set of 42 statements was derived and grouped into six sub-categories within the environment-democracy nexus: (1) Democratization, (2) Environmental Impact Assessment (EIA), (3) Ladder of participation, (4) Trust, (5) Local engagement and PM process, and (6) Citizen science. These categories were discussed during the workshop and are typically used as a theoretical background when introducing participatory tools in the environmental decision-making process [14,15,49], especially how local engagement and citizen science can incorporate, develop, and expand citizens' roles in the democratic system. The application of new techniques (such as PM) and a citizen science approach can serve as democratic innovation toward the effective implementation of EIA as well as building trust and participation in the energy transition. Thus, the categories are set from general (macro) policy to the individual (micro) participatory level.

Next, the 42 statements were tested in a pilot study. Each statement was separately validated by two geoengineers who conduct monitoring research. To limit the impact of subjectivity resulting from suggestions from two experts, each proposal for changing or limiting the statements was discussed in our three-person research team. Based on experts' feedback, we adapted the phrasing and further reduced the number of statements to a Q-sample of 33 (Table 1). The reduction was firstly due to still small differences between some individual statements that the experts considered repetitions. Secondly, according to the experts, a Q-sample of 30 statements would allow participants to control (i.e., "have in mind") all statements. In the view of the experts, a Q-sample of over 40 statements would lead to control loss and result in a more random or thoughtless placement of statements.

2.1.3. Selection of participants: P-set

A P-set is a group of respondents selected to participate in a Q-study. In our study, the P-set consisted of experts recruited from the geo-energy sector who already had experience in communicating their work to local communities. While they are not scientific researchers, they all considered themselves experts in environmental monitoring. We designed the P-set based on three categories: (1) geologists who conduct fieldwork, (2) public administration representatives who conduct environmental impact assessments, and (3) non-governmental organizations working with geo-energy.

We selected 67 participants (Table 2) who were invited by email (three rounds of mailing and reminders) as well as via telephone. However, the recruitment process was long and not very successful due to the COVID-19 pandemic, even when participants were directly contacted via email and telephone. The overload of remote work during the lockdown period caused many problems with reaching and motivating participants to complete the Q-sorts online.

2.1.4. Sorting of statements: Q-sort

A Q-sort is the data collection phase in a Q-study, completed either manually or with the use of online software [50]. Respondents are self-

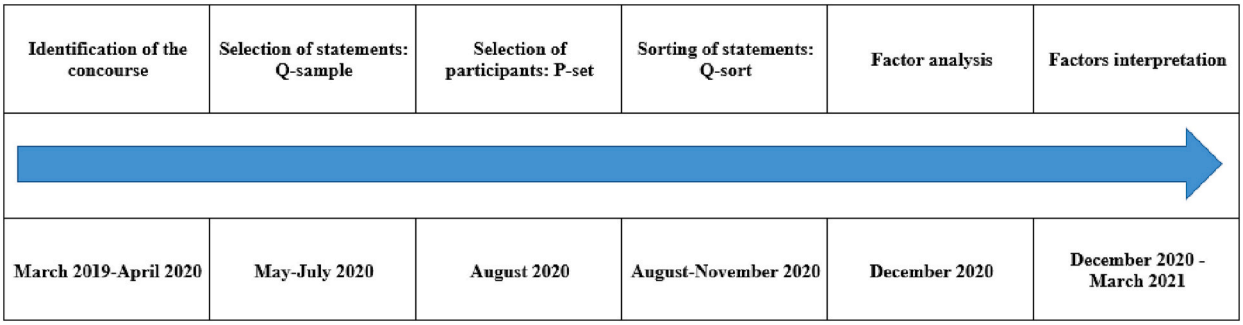

Fig. 1. Timeline of the research procedure in the study.

Table 1
The final statements applied in the study were divided into six categories. Numbers in brackets after dimensions names indicate the number of statements.

No.	Dimension	Statement
1	Democratization (5)	Only those infrastructure projects that have been accepted by local communities should be implemented.
2		It should be made clear to local communities what their interests and benefits in the investment might be.
3		Local communities should be involved in decision-making about geo-energy investments.
4		A just energy transition means involving local communities in the decision-making process of geo-energy projects.
5		Experts should have the final say on the implementation of advanced technologies and subsurface projects.
6	Environmental Impact Assessment, (EIA) (6)	Before implementing large infrastructure projects, formal acceptance (e.g., voting) by local communities is necessary.
7		It is my personal duty and a moral necessity to involve residents in geo-energy projects in their area.
8		EIA procedures do not assume any cooperation between specialists and local communities.
9		My task is to provide technical and/or environmental analysis and not to organize public communication at the same time.
10		The EIA procedures are insufficient for a comprehensive assessment of the environmental and social impacts of the project.
11		There is no culture of dialogue between public administration and society in our country with regard to spatial planning (even more so when it comes to projects carried out in subsurface geological formations).
12	Ladder of participation (6)	There is a need to educate local communities about climate change.
13		A local community should be informed about the extent to which its voice is taken into account when decisions about an investment are made (e.g., advisory, co-determining, decisive).
14		The mere provision of information about subterranean activities in the project is sufficient for the involvement of local communities.
15		A local community should have an influence on the implementation of a project in their own area.
16		Public consultations about a project do more harm than good.
17		The expectations of local communities about their participation in my geo-energy projects go beyond the level I can accept.
18	Trust (5)	Participation of local communities in decision-making processes for geo-energy projects increases the level of trust and reduces the risk of opposition from local communities.
19		Lack of local participation in environmental monitoring increases the level of a community's skepticism about geo-energy projects.
20		Trust in the investor leads to the approval of the whole project.
21		It is the investor's responsibility to provide continuous feedback on the progress of the investment and cooperate with local communities.
22		The media make it difficult to build trust for investments.
23	Local engagement and participatory monitoring process (6)	Environmental monitoring data should be made public.
24		The participation of experts is essential for the implementation of participatory monitoring.
25		Local communities are unable to help in collecting data on environmental impacts.
26		Local communities should have the possibility to choose what should be monitored in their local area.
27		A public (bottom-up) environmental monitoring system financed by public money should be introduced.
28		A participatory monitoring system should be an integrated part of the geo-energy project strategy.
29	Citizen science (5)	Lack of knowledge about technology limits/disqualifies the possibility for local communities to participate in technological projects.
30		Education of local communities about methods to collect data on the environmental impacts of projects will ensure a higher quality of these data.
31		Local communities' knowledge should be used for preparing environmental monitoring programs.
32		The widespread availability of fake news and unreliable data about new geo-energy technologies causes a reluctance of local communities to use them.
33		The implementation of geo-energy projects is needed for climate change mitigation.

Source: own work.

Table 2
Numbers of geo-energy experts who were invited and participated in the study.

	Geologists who conduct fieldwork	Public administration representatives responsible for Environmental Impact Assessment	Non-governmental organizations that work with geo-energy	Total
Invited to Q-sort	26	14	27	67
Participated in Q-sort	11	5	6	22

Source: own work.

directed in a sorting process using a fixed template Q-grid that forms a pyramid containing as many boxes as the number of statements and reflects a normal distribution curve. In our study, we developed a Q-grid based on Fisher and Brown [51], which was implemented in Q Method Software [52] (Fig. 2). The software first offers participants an optional step to preliminarily assign the statements to one of three categories (agree, neutral, do not agree) before sorting them out to fill in the Q-grid. Due to the COVID-19 pandemic, we chose an online approach to conduct the Q-study. Online research has the advantage of being more convenient and time-efficient for both researchers and participants. In the case of our research, the ability to fill out a form without personal contact allowed us to collect data from a variety of experts, though, as mentioned above, the online fatigue of the lockdown period interfered with the recruitment process. Also, as is often the case with online research, we had little control over how participants completed the research tasks, and they could have been distracted or interrupted while

Fig. 2. Q-grid used in the study. Statements were preliminarily put into three categories (agree, neutral, and do not agree), which was an optional step for each participant.

doing the Q-sort.

To validate our online tool, we conducted a pilot Q-sort with four high-profile experts: (1) a geologist from the Polish Geological Survey, (2) an expert on public consultation from the Regional Directorate for Environmental Protection, (3) a public administration expert who deals with geo-energy projects, and (4) a citizen who had participated in public consultation processes on subsurface energy investments. We sent them a link to the study and conducted telephone interviews with them after they completed the sorting of statements. Based on their feedback, we made changes to the final phrasing of statements included in the Q-sample and improved the clarity instructions for participants, which were crucial as it was conducted online without in-person contact between respondent and researcher.

2.1.5. Factor analysis

Analysis in a Q-study involves correlations between individual Q-sorts as the basis for extracting factors that represent shared meanings. Since it is not possible to deductively determine how many factors exist, the number of factors extracted is a judgment made by researchers based on an examination of the empirical data. However, according to Kaiser-Guttman's criterion [53], the factor's eigenvalues should be larger than one with a minimum number of two significantly loading Q-sorts for each factor, i.e., having at least two participants with a statistically significant correlation with a factor [54]. An additional method to determine the number of factors is a scree plot, which allows researchers to observe how the share of variations is explained by subsequent factors changes. The principle is to retain the factors before the slope changes to a long slow decline.

The extracted factors are subsequently rotated to best explain the Q-sorts using varimax methods. The rotated factors are then used to create factor arrays, which are idealized Q-sorts representing the identified narrative expressed through the factor. For this study, we used a centroid factor analysis (CA) for factor extraction, followed by a varimax rotation [55] using Ken-Q Analysis software [56].

2.1.6. Factor interpretation

Interpretation of factor arrays leads to creating meaningful shared narratives. While the developed narratives do not represent the whole population of narratives under investigation, they should represent the central existing narratives related to the investigated topic. We followed interpretations of best practices in Q-methodology studies (e.g., described by Watts and Stenner [54] and implemented by e.g., Rodhouse et al. [57], Kerr et al. [45]), which emphasize that interpretation must be holistic and consider the complete picture painted by the factor Q-scores rather than just extreme scores or distinguishing statements. For this purpose, we used what is described as "crib sheets" [54]. Crib sheets summarise the placement of statements at extreme ranks, distinguishing and consensus statements. Distinguishing statements refer to statements that are ranked as significantly different in one factor compared to all other factors. Consensus statements are statements that do not significantly distinguish between any two factors. The Ken-Q Analysis software produces a "Relative Ranking of Statements" to aid in the creation of crib sheets.

3. Results

We divided the analysis into two parts. First, we conducted a quantitative analysis using the statistical method explained above to yield results in the form of factor characteristics, participant factor loadings, and the factor and z-scores of the statements. Second, we carried out a qualitative interpretation, during which we used the factor arrays to create a narrative that holistically captured the perspective expressed through the factor. We then analyzed the significant participant loadings on this factor and evaluated interpretations of the changes between measurements. For the interpretation of the results, we also used our experience from workshops (Section 2.1.1) and interviews with experts during the pilot study (Section 2.1.2).

3.1. Quantitative analysis

The quantitative analysis produced three factors that together

Table 3
Characteristics of identified factors (F).

Factors	Eigenvalues	% Explained variance	Cumulative % explained variance	Number of significantly loading participants
F1	6.1916	28	28	10
F2	2.32	11	39	7
F3	1.368	6	45	3

Source: own work.

accounted for 45 % of the variability in the data (Table 3).

The correlation matrix presented in Table 4 provides insight into the structure of the factors. It shows the extent to which each factor is correlated or uncorrelated in terms of significant or insignificant loadings [50]. A low correlation suggests the factors have low similarity with each other.

3.2. Qualitative analysis

Below, we present the interpretation of factors to identify coherent narratives (hereinafter referred to as "narratives") based on which we have assigned names that aim to reflect the core of their argument and the description of change between particular measurements.

3.2.1. Narrative 1: "Pro-expert attitude"

According to Narrative 1, named "Pro-expert attitude" (Table 5), the participation of experts is essential for the implementation of PM (#24 – statement number) and they should have the final say on the implementation of advanced technologies and subsurface projects (#5). Local communities should be educated about climate change (#12), and the need for implementing geo-energy projects as a mitigation strategy (#33). Expert knowledge is also emphasized as a means to identify the widespread fake news, myths, unreliable data, and chaotic information that often circle around controversial geo-energy projects and sway local communities away from supporting them (#32). The environmental monitoring data should be made public (#23), particularly in light of the poor dialogue culture between public administration and society (#11). Local communities should know about their interests and benefits regarding the investment as their participation in decision-making processes increases the level of trust and reduces the risk of opposition (#18). This narrative also relatively supports the belief that local community knowledge should be used for preparing environmental monitoring programs (#31) and that experts have a personal duty and moral necessity to involve residents in geo-energy projects in their area (#7). Moreover, this narrative suggests that the media may not be solely responsible for the difficulty in building trust for geo-energy investments (#22). However, the role of the local community should be limited in deciding about project implementation (#1, #3, #4, #6, #15, #19, #26, #28). Nevertheless, in this narrative, the mere provision of information about subterranean activities in the project is not sufficient for the involvement of local communities (#14).

3.2.2. Narrative 2: "Pro-partnership attitude"

Narrative 2 is named "Pro-partnership attitude" (Table 6) since it is dominated by statements asserting that local communities should be actively involved in decision-making about geo-energy investments (#3, #14, #16, #25). Additionally, they should know their role in the decision-making process (#13) as it is related to a just energy transition (#4) and trust building (#18). This narrative also aligns with the belief that a public (bottom-up) environmental monitoring system should be financed with public money (#27) as it is an integral part of geo-energy projects (#28). Although experts should not have the final say in the implementation of advanced subsurface technologies (#5), their participation is considered essential for the implementation of PM (#24). Experts should not be limited to providing only technical and/or environmental analysis (#9), and the lack of knowledge about technology should not restrict the possibility for local communities to participate in technological projects (#29).

The narrative also emphasizes the need to educate local communities about climate change (#12), and the implementation of geo-energy projects is seen as necessary for climate change mitigation (#33). Moreover, there is a call for the environmental monitoring data to be made public (#23), and trust in the investor was perceived as leading to the approval of the whole project (#20). Disagreement with the belief there is no culture of dialogue between public administration and society in one's country regarding spatial planning (#11) might mean that experts have had some positive experiences with communication between stakeholders in the projects.

The ambiguity of this "pro-partnership" narrative is illustrated by the

Table 4
Factor (F) score correlations.

Factors	F1	F2	F3
F1	1	0.3287	0.2231
F2	0.3287	1	0.0283
F3	0.2231	0.0283	1

Source: own work.

Table 5
Narrative 1: "Pro-expert attitude". "C" denotes consensus statements (flagged with an * are non-significant at $p > 0.05$), "D" denotes distinguishing statements (flagged with an * are significant at $p < 0.05$), and "EIA" denotes Environmental Impact Assessment.

No	Statement	Q-score
Highest ranked statements		
24	The participation of experts is essential for the implementation of participatory monitoring.	4D*
5	Experts should have the final say on the implementation of advanced technologies and subsurface projects.	4
Positive statements ranked higher in Narrative 1 than in other narratives		
33	The implementation of geo-energy projects is needed for climate change mitigation.	3D
12	There is a need to educate local communities about climate change.	3
23	Environmental monitoring data should be made public.	3
11	There is no culture of dialogue between public administration and society in our country with regard to spatial planning (even more so when it comes to projects carried out in subsurface geological formations).	2
32	The widespread availability of fake news and unreliable data about new geo-energy technologies causes a reluctance of local communities to use them.	2D*
2	It should be made clear to local communities what their interests and benefits in the investment might be.	2C*
18	Participation of local communities in decision-making processes for geo-energy projects increases the level of trust and reduces the risk of opposition from local communities.	1C*
31	Local communities' knowledge should be used for preparing environmental monitoring programs.	1
7	It is my personal duty and a moral necessity to involve residents in geo-energy projects in their area.	1D*
22	The media make it difficult to build trust for investments.	0D
Negative statements ranked lower in Narrative 1 array than in other narratives		
19	Lack of local participation in environmental monitoring increases the level of a community's skepticism about geo-energy projects.	0
4	A just energy transition means involving local communities in the decision-making process of geo-energy projects.	0
28	A participatory monitoring system should be an integrated part of the geo-energy project strategy.	-1D*
3	Local communities should be involved in decision-making about geo-energy investments.	-2D
14	The mere provision of information about subterranean activities in the project is sufficient for the involvement of local communities.	-3
26	Local communities should have the possibility to choose what should be monitored in their local area.	-3D*
6	Before implementing large infrastructure projects, formal acceptance (e.g., voting) by local communities is necessary.	-3D*
Lowest ranked statements		
15	A local community should have an influence on the implementation of a project in their own area.	-4D*
1	Only those infrastructure projects that have been accepted by local communities should be implemented.	-4D*

Source: own work.

Table 6
Narrative 2: "Pro-partnership attitude". "C" denotes consensus statements (flagged with an * are non-significant at $p > 0.05$), "D" denotes distinguishing statements (flagged with an * are significant at $p < 0.05$), and "EIA" denotes Environmental Impact Assessment.

No	Statement	Q-score
Highest ranked statements		
3	Local communities should be involved in decision-making about geo-energy investments.	4D*
24	The participation of experts is essential for the implementation of participatory monitoring.	4D*
Positive statements ranked higher in Narrative 2 array than in other narratives		
12	There is a need to educate local communities about climate change.	3
33	The implementation of geo-energy projects is needed for climate change mitigation.	3
23	Environmental monitoring data should be made public.	3
20	Trust in the investor leads to the approval of the whole project.	2D*
13	A local community should be informed about the extent to which its voice is taken into account when decisions about investment are made (e.g., advisory, co-determining, decisive).	2C
4	A just energy transition means involving local communities in the decision-making process of geo-energy projects.	2
28	A participatory monitoring system should be an integrated part of the geo-energy project strategy.	1
27	A public (bottom-up) environmental monitoring system financed by public money should be introduced.	1D*
18	Participation of local communities in decision-making processes for geo-energy projects increases the level of trust and reduces the risk of opposition from local communities.	1C*
Negative statements ranked lower in Narrative 2 array than in other narratives		
19	Lack of local participation in environmental monitoring increases the level of a community's skepticism about geo-energy projects.	0
30	Education of local communities about methods to collect data on the environmental impacts of projects will ensure a higher quality of these data.	0
31	Local communities' knowledge should be used for preparing environmental monitoring programs.	-1D*
11	There is no culture of dialogue between public administration and society in our country with regard to spatial planning (even more so when it comes to projects carried out in subsurface geological formations).	-1D*
22	The media make it difficult to build trust for investments.	-2C
5	Experts should have the final say on the implementation of advanced technologies and subsurface projects.	-2D*
14	The mere provision of information about subterranean activities in the project is sufficient for the involvement of local communities.	-3
9	My task is to provide technical and/or environmental analysis and not to organize public communication at the same time.	-3D*
29	Lack of knowledge about technology limits/disqualifies the possibility for local communities to participate in technological projects.	-3D*
Lowest ranked statements		
25	Local communities are unable to help in collecting data on environmental impacts.	-4D
16	Public consultations about a project do more harm than good.	-4D*

Source: own work.

belief that the knowledge of local communities should not be used for preparing environmental monitoring programs (#31), which contradicts the belief about the bottom-up approach (#27).

3.2.3. Narrative 3: "Pro-informative attitude"

According to Narrative 3, named "Pro-informative attitude" (Table 7), experts are perceived as decision-making actors for geo-energy projects (#5) and a lack of knowledge limits the possibility for local communities to participate in technological projects (#29). Although the lack of local participation in environmental monitoring is declared as causing an increase in the level of community skepticism about geo-energy projects (#19), the task of experts is defined as the provision of technical and/or environmental analysis and not the organization of public communication (#7, #9, #24,). In turn, ensuring

Table 7
Narrative 3: "Pro-informative attitude". "C" denotes consensus statements (flagged with an * are non-significant at $p > 0.05$), "D" denotes distinguishing statements (flagged with an * are significant at $p < 0.05$), and "EIA" denotes Environmental Impact Assessment.

No	Statement	Q-score
Highest ranked statements		
5	Experts should have the final say on the implementation of advanced technologies and subsurface projects.	4
29	Lack of knowledge about technology limits/disqualifies the possibility for local communities to participate in technological projects.	4D*
Positive statements ranked higher in Narrative 3 array than in other narratives		
19	Lack of local participation in environmental monitoring increases the level of a community's skepticism about geo-energy projects.	3D
9	My task is to provide technical and/or environmental analysis and not to organize public communication at the same time.	3D*
21	It is the investor's responsibility to provide continuous feedback on the progress of the investment and cooperate with local communities.	3C*
30	Education of local communities about methods to collect data on the environmental impacts of projects will ensure a higher quality of these data.	2D
14	The mere provision of information about subterranean activities in the project is sufficient for the involvement of local communities.	2D*
26	Local communities should have the possibility to choose what should be monitored in their local area.	2D
15	A local community should have an influence on the implementation of a project in their own area.	2
31	Local communities' knowledge should be used for preparing environmental monitoring programs.	1
18	Participation of local communities in decision-making processes for geo-energy projects increases the level of trust and reduces the risk of opposition from local communities.	1C*
6	Before implementing large infrastructure projects, formal acceptance (e.g., voting) by local communities is necessary.	1
Negative statements ranked lower in Narrative 3 array than in other narratives		
24	The participation of experts is essential for the implementation of participatory monitoring.	0D*
13	A local community should be informed about the extent to which its voice is taken into account when decisions about an investment are made (e.g., advisory, co-determining, decisive).	0C
2	It should be made clear to local communities what their interests and benefits in the investment might be.	0C*
23	Environmental monitoring data should be made public.	-1D*
33	The implementation of geo-energy projects is needed for climate change mitigation.	-1D*
32	The widespread availability of fake news and unreliable data about new geo-energy technologies causes a reluctance of local communities to use them.	-1
12	There is a need to educate local communities about climate change.	-2D*
17	The expectations of local communities about their participation in my geo-energy projects go beyond the level I can accept.	-2C*
22	The media make it difficult to build trust for investments.	-2C
7	It is my personal duty and a moral necessity to involve residents in geo-energy projects in their area.	-3
20	Trust in the investor leads to the approval of the whole project.	-3D*
8	EIA procedures do not assume any cooperation between specialists and local communities.	-3D
Lowest ranked statements		
10	The EIA procedures are insufficient for a comprehensive assessment of the environmental and social impacts of the project.	-4D
27	A public (bottom-up) environmental monitoring system financed by public money should be introduced.	-4D*

Source: own work.

the flow of proper information lies mainly with the investor side (#21), but trust in the investor is not seen as being helpful in gaining the project's approval by local communities (#20).

The important thing is to educate local communities about methods to collect data on projects' environmental impacts, which should ensure a higher quality of the collected data (#30), and not about the problem of climate change (#12). The local community should have the possibility to choose what should be monitored in their local area (#26). This narrative supports the use of local communities' knowledge (#31) as well as the need to obtain their acceptance for the investment (#6). In this view, local community participation in geo-energy project decision-making increases trust and reduces local opposition (#18). However, it does not mean that the local community has a key role in data collection or decision-making. According to Narrative 3, the mere provision of information about underground activities in the project is sufficient for the involvement of local communities (#14). Moreover, environmental monitoring data should not necessarily be made public (#23), and a public (bottom-up) environmental monitoring system should not be introduced using public financial resources (#27).

3.3. Similarities and main distinctions in identified narratives

Statements that do not distinguish between any pair of narratives (low z-score variance) are called consensus statements. These are statements with which all narratives either agree or disagree. The consensus statements from our study are shown in Table 8. The greatest consensus was built upon beliefs belonging to the "trust" dimension, as respondents agreed with these statements the most (#18, #21, #22). According to all identified narratives, the participation of local communities in the decision-making process increases the level of trust (and reduces opposition) concerning geo-energy projects. There was also a consensus that continuous feedback on the investment progress and cooperation with local communities is the responsibility of investors. Moreover, the blame for difficulties in building trust for investments is not assigned to the media. Furthermore, a consensus was built upon the belief related to the "ladder of participation" (#13 and #17).

All identified narratives go against the idea that the expectations of local communities regarding their participation in geo-energy projects are higher than what they can accept. Moreover, they support (or at least do not oppose) the belief that the local community should be informed about the extent to which its voice is considered when decisions about investments are made. The results also show support for the belief from the "democratization" dimension that it should be made clear to local communities what their interests and benefits in the investment might be (#2). There is also a consensus in all identified narratives against the statement from the "Environmental Impact Assessment" dimension that EIA procedures do not assume any cooperation between specialists and local communities (#8).

Three types of narratives were built upon the most important disagreements and aforementioned similarities. The main difference between narratives concerns opinions on decision-making and democratic procedures, particularly the belief that experts have the final say on the implementation of advanced technologies and subsurface projects. This statement was the source of the most significant disagreement among the narratives. In addition to the "democracy" dimension, the narratives differ with statements related to the "citizen science" and "ladder of participation" dimensions (#5, #29, #26).

4. Discussion

In this section, we analyze the three collective narratives to outline and discuss areas of overlap and divergence found in experts' reception of PM. This assessment of experts' narratives about PM enables us to identify contexts for hermeneutical justice to occur in possible interactions between experts and non-experts in geo-energy projects. These projects are complex endeavors involving advanced technological and scientific expertise, but they also tend to stir up the non-expert community located in their vicinity, which may trigger social protest and conflict. The Q-methodology tool that we applied in this study allowed the experts to express their attitudes toward non-expert participation in geo-energy projects and helped us to examine various scenarios for their possible engagement with non-experts in future projects.

4.1. Shared consensus and divide between the three identified narratives

The narratives of the studied target groups—geologists, geo-experts from non-governmental organizations, and regional administration units from Poland—suggest that there is no simple, binary opposition between those who support and those who oppose public participation in the context of geo-energy projects. Our findings indicate a consensus among participants regarding the importance of local community engagement in the geo-energy projects for building trust. Also, the responsibility is on the side of the investor for organizing this process. However, the dominant narratives varied the most concerning the role of experts in PM of geo-energy projects and the level of importance of technical knowledge for non-experts when taking part in PM.

This reveals an interesting divide in the identified narratives. While

Table 8
Consensus Statements. All listed statements are non-significant at $p > 0.01$, and those flagged with an * are also non-significant at $p > 0.05$. "EIA" denotes Environmental Impact Assessment.

No of Statement	Statement	Narrative 1: "Pro-expert attitude" - Q-score	Narrative 2: "Pro-partnership attitude" - Q-score	Narrative 3: "Pro-informative attitude" - Q-score	Z-score variance
18*	Participation of local communities in decision-making processes for geo-energy projects increases the level of trust and reduces the risk of opposition from local communities.	1	1	1	0
21*	It is the investor's responsibility to provide continuous feedback on the progress of the investment and cooperate with local communities.	2	2	3	0.018
17*	The expectations of local communities about their participation in my geo-energy projects go beyond the level I can accept.	−1	−1	−2	0.04
2*	It should be made clear to local communities what their interests and benefits in the investment might be.	2	1	0	0.066
22	The media make it difficult to build trust for investments.	0	−2	−2	0.099
13	A local community should be informed about the extent to which its voice is taken into account when decisions about an investment are made (e.g., advisory, co-determining, decisive).	1	2	0	0.1
8	EIA procedures do not assume any cooperation between specialists and local communities.	−2	−2	−3	0.13

Source: own work.

the trust-enhancing nature of public engagement seems to be widely accepted, only some respondents are willing to assign a more independent and equal role to non-experts regarding environmental monitoring or decision-making about the project itself. The role of experts—the inevitability of their participation in any processes related to geo-energy projects and their deciding voice—is a principle that some of our respondents are very attached to. This suggests that although communication with non-experts is seen as desirable, the experts share the narrative about their epistemic dominance over non-experts. Therefore, while interactions between experts and non-experts are valued in experts' narratives, the practical fulfillment of epistemic justice is highly uncertain.

The Q-methodology analysis presented in this study provides a tool that can help understand whether and how experts are open to non-experts' participation and are willing to interact in an epistemically non-dominant way. By drawing on Fricker's discussions of epistemic justice [4,20], this study relates to broader concerns about the liberal political ideal of freedom, which is not limited to energy systems, issues, or practices. In a broader sense, epistemic justice or its opposite—epistemic injustice—can be seen as a component of democratic participation in various areas of public life. Our study is primarily focused on energy projects, which have until recently been left out of the democratic participation of non-experts as a result of their highly technical and traditionally expert-dominated character.

Our results shed light on the general presuppositions toward public engagement in energy technology projects and the hidden attitudes toward more democratic decision-making processes and public participation, specifically in relation to PM in geo-energy projects. However, a risk of epistemic injustice persists as long as the experts' narratives and attitudes are unchanged. The energy transition involves new projects that utilize technologies unfamiliar to local communities, which may result in fear of the unknown, along with procedural and distributive injustices becoming increasingly prevalent. This fear may also intensify emotionally charged social tensions [58], regardless of its basis in reality. Previous research has shown that such tensions may be related to incompatibilities between experts' and non-experts' perspectives. While experts tend to approach technological projects through "matters of fact", non-experts tend to view them through "matters of concern" [59,60]. Moreover, driven by a fear of unknown technologies and a sense of unfair treatment, non-experts may adopt risk avoidance strategies rather than adaptive ones [61,62].

4.2. Specificity of the three identified narratives

The selection of six dimensions and their accompanying statements allowed us to identify three dominant narratives. The first narrative, which emphasizes the importance of expert participation, conveys a vision that public engagement (and PM) is only possible with the acceptance and positive actions toward it by the epistemically dominant group, the experts. It is commonly argued that only the "most relevant experts" should be invited to the consultation process, which reflects an undervaluation of the lay public and a belief that it is impossible to share technical knowledge with non-experts [28,63]. However, in this narrative, there still exists a possibility to include non-technical experts, such as social scientists, who can provide an accurate representation of other stakeholders' voices, particularly those of local communities.

The second narrative, which we characterize as a "pro-partnership", is less frequently represented among the participants but provides a positive view of partnership in decision-making processes and bottom-up environmental monitoring. However, further research is necessary to understand the needs and expectations of those who represent this narrative in terms of what these partnerships could involve, as well as what guidance or support would be needed to make these partnerships work. Would these partnerships hinge upon a non-dominant relationship between experts' and non-experts' epistemic standpoints? Would there be space for the absorption of lay knowledge into institutionalized processes of the monitoring of geo-energy projects? While research on the links between society and science, technology, and innovation over the last few decades has developed into many guidelines and instructive handbooks [63,64], we recommend that these guidelines be further elaborated and nuanced to account for particular contexts that shape the experts' attitudes.

The third, "pro-informative" shared narrative, suggests that experts agree to inform and educate lay people and communities about the geo-energy projects that they carry out. However, they perceive public involvement in environmental monitoring as an unnecessary process and see no benefit in launching it. The pragmatism of experts in evaluating inclusive decision-making processes allows for rather limited one-way communication. In other words, experts prefer to inform rather than listen and confront alternative views [59,63]. This narrative suggests that there is little room for more collaborative ways of engaging lay publics, such as PM, and for both hermeneutical and testimonial justice to occur.

According to Petts and Brooks [63], more attention should be given to studying the culture of expertise, specifically how the understanding of the potential roles and value of lay knowledge develops in environmental decision-making. In practice, creating a more inclusive and epistemically just institutional culture will require the institutional support and cooperation of (local) authorities, who can provide guidance and instructions on the implementation of participatory methods [65,66]. The statement that a "lack of knowledge about technology limits/disqualifies the possibility for local communities to participate in technological projects" (#29) scored the highest variation value, indicating that while some respect local knowledge, others dismiss it as worthless.

Successful implementation of PM undoubtedly requires a carefully crafted administrative framework and a dose of goodwill from investors and project leaders. Experts often believe that PM and participatory tasks belong to a different sector or the communication departments of their organizations, and it is not their obligation to engage with non-experts. This could be related to local participation cultures in which experts operate. Some researchers have declared that administrative rules alone will not improve deliberation and environmental justice [63,65]. However, clear and respected legal guidance is a good starting point that can give a higher status to the activities that could mitigate injustices, including the epistemic and hermeneutic aspects [67,68].

This Q-methodology study of experts' reception of participation and their readiness to use PM techniques may not only play a diagnostic role in geo-energy projects but may also have educational potential. A Q-methodology test tailored to a specific project may become a useful tool for informing and educating experts about epistemic justice. The analysis of narratives that emerge from the Q-sort serves as a valuable source of information for further discussions on how to mitigate potential harms and injustices, which can have damaging consequences for non-experts involved in project implementation—even if unintentional from the experts' side. Therefore, a well-designed Q-sort test can help to describe the context for participatory democracy in practice and the experts' willingness to empower citizens [69]. Q-methodology assessments can not only identify and address future injustices, particularly procedural or relating to recognition, but they can also reveal relationships that may lead to epistemic injustices.

4.3. Contexts for hermeneutical justice in interactions between experts and non-experts

Our study has shown that hermeneutical justice in PM is contextual, and the three different narratives that we identified provide different contexts for its actualization in practice. The preconceptions shared within these narratives reveal varying degrees of openness to non-expert voices—from emphasizing the inevitability of expert involvement in any kind of public participation process, through some ideas of partnerships between experts and non-experts, to one-way communication of project-

relevant information from experts to non-experts. The first narrative implies that non-experts are listened to by experts with a carefully tuned ear for any slippages, improper wording, or irrelevant speech [70]. The second narrative most likely presents the greatest potential for achieving hermeneutical justice in PM practice by suggesting that an idea of partnership in communication exists. The third narrative conveys the weakest potential for epistemic (in particular hermeneutical) justice to be fulfilled, representing a traditional one-way communication that only provides non-experts with information. The voice of non-experts becomes less relevant in this narrative, and, thus, potentially less eagerly listened to.

We believe that the profile of the experts in our study may have had an impact on the obtained results. Issues related to geo-energy are less known to the general public, which may cause experts to emphasize the importance of non-expert knowledge more than in the case of, e.g., land use management. The latter is a subject of participatory processes practically in all municipalities in Poland, and many other countries - local community engagement in spatial planning is often required by law. Therefore, on the one hand, experts involved in spatial planning could be more accustomed to the participation of "non-experts" than, for example, geo-engineers, and, on the other hand, "non-experts" could have a relatively higher level of knowledge on spatial planning than on geo-energy, considering that spatial planning is closer to their everyday life and they have more experience with it.

4.4. Limitations

There are two main limitations of our study that go beyond the limitation of a single case study approach, which hinders the generalization of our results.

Firstly, it is important to acknowledge that there can be potential misunderstandings when using the statements in Q-methodology. Although it requires several iterations and testing with experts, which we included in our procedure to ensure accuracy, the interpretation of the statements may vary among different experts leading to potential discrepancies in the Q-sort results. To address this issue, we found it important to discuss these statements with the respondents before the actual Q-sort or to organize online meetings and conduct interviews while the person fills out the Q-sort.

Secondly, the main obstacle that we experienced when carrying out our study was a low participation rate, as experts did not consider it beneficial to participate in the Q-methodology study. Some participants did not understand the purpose of the Q-methodology and the online variant. The COVID-19 pandemic made it even more challenging for us to explain the purpose of the study than it would have been in a face-to-face interaction. In addition, the pandemic also caused some experts to feel "Zoom fatigue"—a common negative effect of the prolonged use of computer-mediated communication [71]. This resulted in a relatively small P-set size. Previous studies have suggested that including 40–60 participants is ideal, but it is still possible to obtain relevant results with fewer participants [72].

5. Conclusions and policy implications

The concept of epistemic justice, understood as epistemic non-domination, can be seen as both a necessary prerequisite for energy democracy in practice and an ideal quality of interactions taking place within the framework of public participation in energy technology projects. However, achieving epistemic justice can neither be taken for granted nor assumed to be impossible to achieve. Rather, as shown by our study, it should be assumed that epistemic justice in participatory practices is highly contingent upon the context within which a given interaction takes place. This context is created by various factors: participatory tools (PM in our case), type of projects (geoengineering in our case), many structural conditions, and also the experts' prior attitudes to public participation in their specific field of expertise.

In order to foster energy democracy, it is important to establish trust and implement participatory decision-making processes that include a diverse range of stakeholder perspectives, which should be considered one of the responsibilities of experts. This would require education on all sides. Experts should be encouraged to reflect on their own knowledge and consider the value of local knowledge, while non-experts should be educated about their rights and cooperative possibilities. Additionally, non-expert perceptions of a particular project may be anchored in bad experiences of participatory processes from the past [73]. This may occur when experts apply a "decide-announce-defend" model of project implementation by using participatory activities to justify previously made decisions rather than inform about consequent project stages [74]. To avoid this, we suggest promoting diversity and inclusiveness within technological and other types of geo-energy projects, i.e., by also incorporating communication and social science specialists who can have an impact on the project management plan.

In conclusion, our study highlights two main policy implementations for the future. First, experts—as the more powerful actors - should take responsibility for fair procedures and be better equipped (educated) with competencies for reflecting on the acceptance of local knowledge. Second, greater diversity and inclusivity should be promoted in academic and other geo-energy projects, with founders/investors including tasks for inclusiveness and participation of non-experts as an obligatory part of the projects.

Our study serves as an invitation to experiment with the Q-methodology assessment tool for various technological projects. While we chose to focus on geo-energy projects and PM, we believe that our approach can prove useful for understanding experts' attitudes toward public engagement in other types of infrastructural and technological projects (including hydrogen heating, energy power plants, water treatment plants, land use management, environmental management, etc.).

The Q-methodology approach should not be considered as a standalone tool for understanding contexts favorable to public engagement but should rather be seen as a complementary one to in-depth interviews and workshops with various groups of stakeholders. The value of the Q-methodology approach lies in its ability to discover agreement and disagreement regarding particular statements and organize them into narratives. We believe that in addition to its diagnostic potential, the Q-methodology tool can also serve as a starting point for conversations about various dimensions of public engagement as well as help experts differentiate between those dimensions and position themselves within a broader scope of pro-engagement attitudes. Similar studies using our Q-methodology tool would help to reveal other types of narratives that take into account the national or regional governance cultures of experts [75,76], and could contribute to the improvement of the tool itself. Finally, we view our Q-methodology tool as a valuable aid for discussing and operationalizing various aspects of energy and environmental justice, including its most recently proposed dimension, epistemic justice.

Declaration of competing interest

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

Data availability

Data will be made available on request.

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