User-Centred Energy Systems

Drivers and barriers of public engagement in energy infrastructure

Literature review and expert interviews

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Abbreviations

Name	Abbreviation
Canada Energy Regulator	CER
Decide-Announce-Defend (model)	DAD
Engage-Deliberate-Design (approach)	EDD
Environmental Assessment	EA
Environmental Impact Assessments	EIA
European Union	EU
Germany’s Energy Industry Law	EnWG
Grid Expansion Acceleration law	NABEG
Infrastructure Planning Commission	IPC
Institute for European Energy and Climate Policy	IEECP
Non-Governmental Organizations	NGOs
Not In My Backyard	NIMBY
Organisation for Economic Co-operation and Development	OECD
Offshore Renewable Electricity Support Scheme	ORESS
Photovoltaic	PV
Renewable Electricity Support Scheme	RESS
Renewables Grid Initiative	RGI
Social License to Operate	SLO
Transmission System Operators	TSOs
United Kingdom	UK
United Nations Economic Commission for Europe	UNECE
United States of America	USA / US

Executive summary

Public engagement for energy infrastructure is of increasing importance as public opposition to projects such as wind farms or electricity grids poses challenges to meeting climate and energy targets. As energy infrastructure moves closer to people's homes, there is a call for effective and meaningful public engagement on energy infrastructure projects. But what drives or retains public engagement in energy infrastructure? The aim of this report is to identify common socio-psychological, socio-technical and institutional challenges and drivers for effective public engagement in energy infrastructure, and to explore how barriers can be overcome. It analyzes both the drivers and barriers for people engaging with energy and for developers and institutions engaging with people.

To do so, Public Engagement for Energy Infrastructure Task was created and funded in 2023 by participating UsersTCP countries (United Kingdom, Ireland, Netherlands, Sweden and Switzerland). The Institute for European Energy and Climate Policy (IEECP) and the Renewables Grid Initiative (RGI) are the Task Leaders.

The infrastructure focus of this report is on renewable energy production (wind, solar, biomass) and electricity grids, as these are available technologies and central to decarbonize energy systems. The research is based on an extensive literature review and interviews with 26 experts from policymaking, the energy industry, non-governmental organizations, consultancies and academia.

The study finds that different forms and levels of public engagement, ranging from informing to consulting and empowering, are practiced by different actors. People are motivated to engage with energy infrastructure projects if they are affected and if they have the mandate to influence decisions and can financially benefit. Institutions and developers can drive of public engagement in energy infrastructure by engaging the public early and continuously, by addressing the concerns of affected people, communication timely and transparently, devolving of decision-making power to the public, and providing legal requirements.

The main barriers to the public engaging with energy infrastructure are their lack of awareness about developments and their benefits, as well as the lack of trust in developers or local authorities. Key barriers for institutions and developers to engage with the public are insufficient knowledge and consideration of citizens values and needed, lack of skills to design meaningful public engagement processes, and lack of participation and legal frameworks.

Public engagement with energy infrastructure can take many forms and should focus on more than building public acceptance. Among other benefits, meaningful public engagement on energy infrastructure projects allows the public to voice concerns and opinions about technologies and their location (siting), can improve the quality and legitimacy of decisions, can lead to better-informed decisions that meet public needs, and can build trust between project developers and the community. To achieve meaningful public engagement, it is important to recognize the significance of local contexts, local conditions, societal values, and public concerns and needs where energy projects are being implemented.

Based on the key findings, we make three main policy recommendations:

1. Policymakers need to better communicate and raise awareness about the opportunities for public engagement with energy infrastructure projects. This engagement should highlight that infrastructure projects are key to enabling the energy transition and can bring benefits to the public. Any engagement strategy should also aim to integrate national climate and energy action plans into the local context of citizens.
2. Greater awareness and capacity building is needed for businesses, including planners and developers, on the importance of public engagement for a rapid and just energy transition, including best practices for public engagement.
3. There is a need for closer cooperation between different actors to enable knowledge sharing and collaboration on public engagement with energy infrastructure projects. Policy makers should initiate a "community of practice" to enable different actors to share experiences and initiate mutual learning within and across energy technologies, and to ensure that engagement processes on the ground are inclusive and equitable.

1 Introduction

A deep and rapid transformation of energy systems is needed to keep global average temperature rise well below 2°C, as set out in the Paris Climate Agreement, while ensuring affordable and secure energy services [1]. While the highest ever global deployment of renewable electricity capacity occurred in 2022, greater progress is needed in most areas of the energy system to reach global climate goals [2]. The energy transition requires new investments in generation, transmission and distribution assets [3], which will lead to infrastructure projects that are likely to be closer to people and communities. This is because the emergence of renewable energy technologies (e.g., solar panels and wind turbines) offers the opportunity to generate energy in a more decentralized way [4], which is either used locally or distributed through transmission networks to where the demand is [5]. At the same time, the scale of infrastructure needed to meet climate and energy targets requires significant land to build on [6], which has sometimes led to local disagreements over land use and the environmental impacts of the infrastructure. To address this challenge, the European Commission, for example, has asked Member States to identify “go-to areas” on land or at sea that are particularly suitable for renewable energy infrastructure and where deployment is not expected to have significant environmental impacts [7]. As such, energy transitions, and especially large infrastructure projects, involve social, economic and political changes that require meaningful societal engagement [8].

While public support for the energy transition is generally high, specifically among European citizens [9], energy infrastructure developments are often met with public opposition on the ground [10]. Many factors can lead to public opposition; some of these factors include mismatches with place-related identities and attachments [11], [12], fears of citizens and sometimes even entire social groups of its negative impacts on wildlife, agriculture, fisheries, or visual landscape [13]–[15], and political ideologies and debates [16], [17]. A lack of public acceptance can halt or delay infrastructure projects [18], [19], which can lead to unstable services, increased costs, challenges in meeting climate targets, and other consequences [20].

At the same time, the governance and geopolitical structures and institutional factors of different countries or regions can also influence the public acceptance of energy infrastructure. This is because different jurisdictions have different public engagement practices and experiences [21], which can influence public perception of the processes, including factors related to people’s level of familiarity with specific technologies and their level of trust in the stakeholders involved [22], [23]. These elements demonstrate that technological solutions require political and social support to successfully accelerate the energy transition.

Public engagement is increasingly recognized as a crucial factor in coordinating diverse interests and facilitating the representation of different perspectives [8], [24], [25], while enhancing the legitimacy of the planning process [26]. It is often associated with the expectation of reconciling the ‘social gap’ between the high-level public approval of the energy transition and public hostility towards concrete implementation measures in practice [27]. Research has found that opportunities for participation can positively influence the acceptance of energy infrastructure projects [28]–[31]. Public engagement also has the potential to address social, economic and spatial injustices in the energy transition [32].

In many countries, public engagement around the energy transition is high on the political agenda to increase acceptance of decarbonization policies and to reap the local and regional co-benefits of sustainable transformations. For example, the European Green Deal states that:

> "[it] aims to protect, conserve and enhance the EU's natural capital, and protect the health and well-being of citizens from environment-related risks and impacts. At the same time, this transition must be just and inclusive. (...) Since it will bring substantial change, active public participation and confidence in the transition is paramount if policies are to work and be accepted". [33]

Previous studies have looked at public participation in energy infrastructure, often with a focus on acceptance or best practices. No study has investigated the different drivers and barriers to public participation for both the public and institutions/developers.

1.1 Objective and guiding questions

To provide insights on how the public could and should be engaged in energy infrastructure developments to overcome challenges and speed up the implementation of just energy projects, the Public Engagement for Energy Infrastructure Task was created and funded in 2023 by participating UsersTCP countries (United Kingdom, Ireland, Netherlands, Sweden and Switzerland). The Institute for European Energy and Climate Policy (IEECP) and Renewables Grid Initiative (RGI) are the Task Leaders and authors of this report.

The objective of this report is to identify common socio-psychological, socio-technical, and institutional challenges and drivers to effective public engagement in energy infrastructure, and to explore how existing barriers to meaningful public engagement can be overcome. The report provides implications for effective public engagement, including useful formats and levels of engagement. The guiding questions are:

i. What are the socio-psychological, socio-technical, and institutional drivers and barriers to acceptance of energy infrastructure projects and participation in energy infrastructure decision-making?[1]

ii. When and why have infrastructure projects failed due to a lack of good public engagement?

iii. Which forms of public engagement are suitable for achieving acceptance of energy infrastructure projects and fair and inclusive decision-making around energy infrastructure?

1.2 Background on public engagement and energy infrastructure

The term *public engagement* is not commonly, and sometimes imprecisely, defined [34]. It is often used interchangeably with public participation, citizen participation and citizen involvement[2]. This leads to the fact that the different forms of participation, such as public hearings, or taking part in a discussion debate are not always clearly distinguished [35]. Rowe and Frewer [34] describe public engagement as the involvement of publics or groups

[1] These includes drivers and barriers for individuals, groups, institutional structures, and wider governance contexts.
[2] In this study, the terms public engagement and public participation are used interchangeably.

in agenda-setting, decision-making, and policy-forming activities. Understanding and defining the different purposes of public engagement is also important in assessing whether or not a public engagement process is effective. This is because effectiveness is related to the question of whether the stated purpose of the participation process was achieved [34]. As such, participation requires ‘spaces’ for participation, such as opportunities, moments and channels, through which the public can act to potentially affect policies, discourses, decisions and relationships that impact their lives and interests [36], [37].

Similar to the definition of public engagement, it is often not clearly defined what the *public* is [38]. The “general public” can be seen as “an unorganized collection of individuals”, whereas stakeholders are organized groups [38] (p. 1). Recognizing that there is no such thing as "the public" or "the people", because societies are complex and made up of different individuals, we use the term *public* in this study for simplicity’s sake. Like the definitions, instruments, techniques, methods and tools, etc., to facilitate public participation also tend to be lightly defined [34]. This gap underscores the urgency to explore different forms of public engagement as well as drivers and barriers for the development of energy infrastructure.

In the context of this Task, public engagement is defined as the involvement of the public in various stages of energy infrastructure projects, including need definition, planning, permitting, and implementation, as well as in the sharing of medium- and long-term socio-economic benefits (such as financial participation and regional value creation). This study distinguishes between three levels, or typologies, of participation [39]:

1. Information: one-way communication and dissemination of information to increase awareness and understanding of issues. This includes digital platforms (such as websites) that, once people are ‘aware’ of, can be used as resources. There is no opportunity for the public to provide input or to influence the project outcome.
2. Consultation: two-way flow of communication in which views, attitudes, and knowledge are gathered, e.g., via surveys, interviews, or workshops. Thus, the public can shape the project process, but not the key objectives and outcomes.
3. Empowerment: two-way community-led engagement, where the public itself can co-design and shape the project process, its objectives, scope and outcomes.

Different *energy infrastructures* can present distinct opportunities for public engagement and experience technology-specific acceptance factors [40]–[42]. The technology focus of this study is on energy generation infrastructure (e.g., wind power technologies, solar systems), as well as electricity distribution and transmission grids. We chose this focus because wind and solar technologies are driving the growth of renewable energy generation [43] and are the most cost-efficient options with the highest contribution to climate change mitigation [44]. At the same time, the insufficient deployment of electricity distribution and transmission grids that allow the integration of renewables into the energy system and provide flexibility for variable renewable energy sources is considered a major bottleneck for progress in the energy transition [45], [46]. The study also considered literature and expert experiences related to public engagement in related energy technologies, such as green hydrogen or energy storage.

2 Study scope and methods

The study used two methods to investigate drivers and barriers to participation and good practice in participation in energy infrastructure development: a literature review and expert interviews. The methods build on each other so that the results complement each other and can be integrated.

The scope of the study is public participation in large-scale, on-site energy infrastructure, specifically renewable energy production (i.e., solar, wind, biomass) and electricity transmission and distribution[3]. It does not cover individual actions such as installing solar panels on the roof of a house. Community energy is also not a focus of the study and was only considered when, for example, collective ownership models were proposed by developers. Furthermore, this study focuses on *public engagement* and not on the wider literature on *public acceptance*, so articles that examine only acceptance of energy infrastructure have not been included in the analysis.

Following the call by Devine-Wright [47], the study applies an emplacement perspective for public engagement that goes beyond considering 'sites' or 'backyards' for development, while thinking of the places and their social, cultural and environmental notions and values when studying infrastructure developments.

2.1 Literature review

First, a comprehensive review of academic and grey literature was performed. The aim was to (I) collect and review different socio-psychological, socio-technical, and institutional drivers and barriers of public engagement in energy infrastructure developments, and (II) explore various methods and formats of involving different societal groups and individuals in energy infrastructure developments from distinctive countries. The research identified motivations for participation in and opposition towards energy infrastructure processes. Further details on the research approach are provided in **ANNEX 1: Literature review approach**.

In total, 73 articles, reports and books were reviewed. Some articles were review papers, others single case studies, with most cases from Europe and North America. In addition, most available articles focused on wind energy and grid infrastructure, which limits the representation of other technologies, such as solar energy or biomass.

2.2 Expert interviews

The literature review was completed with 25 semi-structured interviews with 26 experts to develop a more complete picture. The aim of the interviews was to discuss key drivers and barriers, as well as good practice cases of public engagement around energy infrastructure.

The selection of expert interviewees was based on stakeholder mapping with all Task Participants in April 2023, existing contacts, and snowball sampling from interviewees. All Task participating member countries, as well as other countries participating in UsersTCP

[3] The terms transmission and distribution denote electricity movement at different voltage levels and points of contact. Transmission grid (extra high voltage level) transports large quantities of electricity from the large renewable to the regions or larger industries across large distances and with very little electricity loss at the 220 or 380 kilovolts (kV). The transmission grid connects electricity systems of neighbouring countries and enable the transnational exchange of electricity. Distribution grid (high voltage: 110 kV; medium voltage: 3-30 kV; low voltage: less than 1 kV) ensures electricity provision to conurbations, some industries, larger facilities (e.g., hospitals) and domestic users. [157]

and beyond, were represented in expert interviews. Different forms of expertise were also represented, including policymaking, energy industry, non-governmental organizations, research and consulting (**Table 1**). Gender representation was balanced across interviewees.

Table 1: Conducted interviews.

Stakeholder groups: / **Countries:**	Policymaking	Energy industry	Non-governmental organization	Research and consulting	Total per country
European Union	1	1			2
Denmark		2			2
Netherlands	1	3			4
Ireland	2	2*	1	2	7
Sweden		2		1	3
Switzerland		1	1		2
Romania		1			1
United Kingdom	2	1		1	4
Total per stakeholder group	6	13	2	4	25

*Note: One interview was conducted with two experts.

The interviews were conducted between June and October 2023. They followed a semi-structured interview guideline (see **ANNEX 2: Interview guideline**), which was developed considering the literature review, an internal feedback round with stakeholders representing energy industry and NGOs, and refined by feedback from the country representatives. The interviews were conducted in English and online via MS Teams, except for one interview conducted over the phone. They were recorded and the main content, including interesting direct quotations, transcribed.

The interviews were analyzed following an abductive approach [48]. This implies that the data were organized in a predefined conceptual structure to maintain alignment with the research questions. However, flexibility was kept by adapting questions as each interview unfolded. This structure also ensured a consistent, thematic analysis of the data across interviews and cases, supporting the exploration of explanations for specific phenomena. After the analysis, the results of the interviews were also compared at a high level with the results of the literature review.

The following section presents the results from a comprehensive literature review and expert interviews[4] on public engagement for energy infrastructure.

[4] The terms „expert“ or „interviewee“ are used interchangeably in the text. The number indicates the respective interviewed experts.

3 Results

Today, citizens and communities "live with, in, around, and through energy" [8] **(p. 38) – both by implementing energy technologies and by being affected by new energy infrastructure projects, which are built near their homes.** Devine-Wright and Sherry-Brennan [49] have described a 'community of locality', which is defined by its spatial proximity to the infrastructure project. This terminology is used to identify who is affected, as well as who should be involved in project development and where benefits should be distributed.

Most of the reviewed literature on public engagement examined how citizens and local communities in close geographical proximity to energy infrastructure are affected. Wind energy and grid infrastructure developments in rural areas receive considerable attention. Given the renewable energy and grid infrastructure development goals of many countries [50], it is likely that many citizens and communities, particularly in rural areas, will encounter energy infrastructure projects in their regions. Therefore, public engagement with energy infrastructure is crucial to build trust and support for projects.

3.1 Levels and purposes of public engagement

The interviews demonstrated that experts have different understandings of what public engagement is. While for some, it means to listen and inform (Interviewee 4), for others it means to "have a say", or "have a share" (Interviewee 6), or actively "shaping the (energy) system together" (Interviewee 22), and "guiding the public through change" (Interviewee 5). This observation already indicates that public engagement can take different forms or levels, depending on individual understandings, the country or political systems.

The reviewed literature and the expert interviews reveal different levels of public participation: from information (one-way communication) to consultation and co-production (two-way communication) [39]**.** In her pioneering work, Arnstein [51] developed the ladder of participation. Each rung on the ladder represents an increase in decision-making influence granted to the public. The ladder consists of two forms of non-participation – manipulation, therapy[5] – and six levels of participation: informing, consultation, placation, partnership, delegated power and citizen control.

All forms of participation can be useful, as various types of engagement can achieve the engagement goals in certain contexts [52], and publics may have diverse preferences for their participation [53] [18]. Available research shows that most of the public prefers high level of consultation [30], or active participation [53] where they have the possibility to influence the decision-making during the planning and approval stages [54].

Pandey and Sharma [55] also argued that citizens may choose not to participate, which can be seen as resistance against pre-defined roles and identities in the decision-making processes. Citizens can also self-initiate participation, outside or in parallel to existing, invited participation opportunities, such as in form of self-organized meetings, the

[5] Manipulation and therapy can be understood as participations where public opinions are suppressed in some way.

engagement of external experts and the use of social media, to express their views and opinions on renewable energy decisions or projects that affect them [36].

Still, most of the projects reviewed in the literature remained at the level of informing or consulting rather than empowering the public. Notably differences have been found between different scales of technology deployment: more active public engagement takes place at smaller scale infrastructure, in comparison to a more passive engagement at larger scale infrastructure [56]. Moreover, also socio-economic factors, such as gender, age, income, and education, as well as knowledge about renewable energy technologies, can influence the level of public engagement in energy infrastructure projects [30], [53].

Current debates on public engagement have called for participation approaches that address the "systemic nature of the challenge" [24] (p. 250). This means that public engagement is not only considered as isolated processes, but rather delivers a "broader perspective on how diverse practices of participation interrelate and connect up across wider systems" [24] (p. 250). Related to that, one expert (Interviewee 1) explained three "waves" of the evolution of public engagement: the first wave focuses on how to communicate more effectively, which is "necessary but not sufficient on its own." The second wave is about how to engage the public well by addressing different concerns and needs through deliberative processes. The third wave is about looking at public participation from a broader systems perspective that is not just about individual technologies, but about their integration into the social system.

The literature review and expert interviews presented different reasons why the public should be engaged in certain infrastructure developments, including the following:

- To give the public a voice in decision that affect them, such as infrastructures which are changing their landscapes and neighborhoods;
- To allow project promoters to listen to the public's opinions, needs and ideas to address concerns and encounter possible conflicts;
- To legitimize the decision-making processes carried out by the project promoters;
- To inform the public about planned projects;
- To raise awareness among the public about the infrastructure needed to progress with the energy transition, participation opportunities, among others, and receive interest;
- To increase understanding why certain projects in certain localities are needed;
- To build relationships and create trust amongst the public in businesses and local governments;
- To increase the likelihood of effective project siting;
- To decrease opposition towards and increase acceptance for infrastructure projects;
- To make decisions on practical local knowledge about the local pre-conditions;
- To collect feedback and understand public preferences;
- To collaborate and jointly promote projects;
- To discuss planning, siting and ownership of infrastructure;
- To discuss potential community benefits.

One expert stated:

> "[…] the point is that the infrastructure is really very crucial for our society on all kinds of elements and that's why I think that the people should be involved […]". (Interviewee 22)

Related to the different purposes for public engagement, Armeni and Anker [57] describe that public participation can be promoted through three different rationales:

- Procedural rationale, which pursues the legitimacy of decision-making by involving residents affected by the infrastructure. This is in line with the Aarhus Convention. For example, for a transmission grids in Germany, Komendantova and Battaglini [58] stated: “The major goal of the process was to increase awareness about the project, to create trust to the company and to facilitate the planning process through dialogue with stakeholders” (p. 227).
- Substantial rationale, which understands that lay knowledge can improve the environmental protection on site. For example, one expert (Interviewee 2) emphasized that when the public is more closely connected to the local context, they are often more aware of what is feasible and what potential advantages or dangers exist in specific sites.
- Instrumental rationale, which complements the aforementioned elements by viewing participation as a way of facilitating the implementation of policies. As such, public engagement can add value to the implementation of local energy infrastructure, but also to advancing policy implementation (Interviewee 2).

3.2 Drivers and barriers of public engagement

There are several factors that can encourage and discourage public involvement in energy infrastructure projects. It is important to note that this report considers two dimensions: the motivations and barriers for public to engage with energy infrastructure and the drivers and barriers of project institutions/developers are facing when engaging (with) the public. The following two sections provide an overview of common drivers and barriers across energy infrastructure stemming from the literature review and the expert interviews.

Many identified drivers and barriers of public engagement overlap between findings from the literature review and the interviews. A sense of agency and an early and ongoing invitation to participate are consistently shown to be very strong drivers of public engagement. Aspects of justice and fairness are much more explicit in the literature to date, although they are also addressed indirectly in interviews. A lack of public knowledge about projects and their benefits, insufficient recognition of the importance of public engagement in companies and governments, and a lack of trust in companies and local governments to implement energy infrastructure projects were prominent barriers across the literature and interviews. The need to make participation easy and accessible was only raised during interviews.

3.2.1 Drivers of public engagement

The literature review revealed diverse socio-psychological, socio-economic, legal and institutional drivers and barriers of public engagement in energy infrastructure planning and projects. Key factors are summarized in **Table 2** for drivers on pages 15-16.

Motivations of people to engage with energy infrastructure

First, people want to be heard and represented in energy infrastructure projects that affect them [58], [59] (Interviewee 3, 8, 18, 20). The experts noted that energy infrastructure projects can be seen as a “crisis” to people; thus, people do participate because they are

affected, or have a local stake, they are concerned and want to have a say (Interviewees 1, 3, 5, 7, 13, 19, 20). Studies found that people are emotionally attached to their land [20] , and have different concerns about the local impacts of energy infrastructure, such as visual or health impacts or decrease in property value [54], [58], [60]–[63].

Some people are also motivated by wider environmental concerns (Interviewee 2, 6, 9, 11, 16, 19, 22), such as the threat of climate change [64], or a desire for more sustainable lifestyles resulting from local clean energy production [65]. Related to that, the public might be specifically interested in and support renewable energy projects that integrate ecological aims and contribute to sustainable development [66]. Interviewee 16 referred to a broader climate strategy that includes information on the infrastructure needed to meet national climate targets, which the public is aware of and can actively contribute to, but which is also constantly evolving in response to public feedback:

> "So, where we need to move to is to a climate literate society where people understand what are the key actions that have impact and then be able to choose from that, almost like a dashboard." (Interviewee 16)

However, it may also be broader energy concerns that make people care: Interviewee 22 emphasized that the energy crisis, with higher electricity and heating costs, has made people more interested in energy in general.

There are different drivers related to how the *process* of public engagement is designed.

People are motivated to participate in energy infrastructure developments if they feel they have agency and the mandate to influence a decision [39], [67]. One expert stressed that it is "a basic right to voice your concerns" (Interviewee 5). Another interviewee added that the choice itself for engagement is important (Interviewee 6), which does not necessarily mean that everyone needs to participate (Interviewee 5). Coleby et al. [68] found that people value the opportunity to respond to wind turbine siting in real-life situations and consider their visual appearance on the landscape. Interviewee 6 said:

> "If you increase public engagement, it comes also to the question where infrastructure should be built and what are the consequences of infrastructure." (Interviewee 6)

It may be even more important for people to have their views considered in the decision-making process than to participate financially in projects [31]. Providing this decision opportunity requires that people receive options (e.g., where the infrastructure shall be located), rather than information about pre-made decisions [67]. If people feel they are part of the decision-making process, they are more likely to support projects (Interviewee 5, 10). Communities can be motivated to be engaged by examples of people successfully influencing project development [66]. What seems to be crucial is that the responses of the public are recorded and documented on how they have influenced the decision and if not, so that the public received information why their input did not influence the process (but was considered) (Interviewee 8, 18) [69].

Table 2: Drivers of public engagement in energy infrastructure based on the literature review and expert interviews.

Driver category	Type of driver	Concerned actors	Found in what country context	Found for what technology	Literature references	Expert reference (interview number)
People are affected and concerned	Socio-psychological	Public	Denmark, Germany, Netherlands, United Kingdom (UK)	Wind energy, grid development	[58], [59]	1, 3, 5, 7, 19, 20, 25
Wider environmental concerns and sustainability motivation to support	Socio-psychological	Public	Denmark, Germany, Netherlands, Review of 15 case studies	Renewable energy, storage	[64], [65]	2, 6, 9, 11, 16, 19, 22
Feeling of agency and mandate to influence decisions	Socio-psychological	Public	Canada, Germany, Scotland, Uganda, Zambia	Wind energy, renewable energy	[31], [39], [67]	3, 5, 8, 10, 12
Fair perceived process	Socio-psychological	Public	Germany, Norway, United Kingdom, Sweden, global (literature review)	Transmission grids, renewable energy transition, onshore wind energy	[31], [67], [70]-[72]	8, 19
Solution fits to wider sustainable local development	Socio-psychological	Public	Netherlands, Ireland, Switzerland	Wind energy	[54]	2, 3 ,4, 6, 7
Financial incentives and community benefits	Socio-economic	Public	Canada, Denmark, Germany, Scotland, Sweden, global (literature review)	Wind energy, wind energy combined with hydrogen	[77], [78]	2, 4, 6, 7, 11, 18, 19, 22, 24, 25
Local (co-)ownership	Socio-economic	Public	Review of 15 case studies, global (literature review), Denmark	Storage (mainly in combination with solar photovoltaic), onshore wind	[54], [65], [72]	2, 4, 7, 13, 23
Sense of community	Socio-psychological	Public	Review of 15 case studies	Storage (mainly in combination with solar photovoltaic)	[65]	24
Make participation easy	Institutional	Developers, governments	UK, Netherlands, Ireland	Renewable energy, wind energy, grids		1 ,2, 4, 5
Early and ongoing participation invitation	Institutional	Public, developers, governments	Germany, Netherland, Norway, UK / Scotland, Sweden, Switzerland	Transmission grids, wind energy	[5], [39], [70], [80]	2, 6, 7, 8, 10, 12, 18, 19, 20, 23, 25

Clear communication, and timely, transparent, and reliable provision of information	Institutional	Developers, governments	Denmark, Germany, Ireland, Netherlands, Scotland, Switzerland	Transmission grid, wind energy, energy strategy	[39], [81]-[83]	1, 2, 5, 7, 12, 15, 18, 19, 20, 25
Raising awareness and capacities building	Institutional	Developers, governments	Germany, Netherlands, Scotland	Wind power, transmission grids	[19], [39], [58]	
Harnessing local knowledge	Institutional	Developers	Czech Republic, Denmark, Netherlands, South Africa, UK / England,	Wind energy, solar energy	[57], [62], [77], [78]	1
Local traditional or opinion leaders, or “liaisons”	Institutional	Public	Denmark, Romania, Uganda, Zambia	Renewable energy, wind energy	[53], [54]	1, 2, 15
Local people or authorities lead engagement processes	Socio-technical, institutional	Public, governments	Ireland, Netherlands, UK,	Renewable energy, solar energy, grids	[54]	1, 2, 7
Economic interests by the private sector	Socio-economic, institutional	Developers, governments	Ireland	Grid, wind energy		3, 11, 22, 24
Legal requirement of public engagement	Legal	Developers, governments	Canada; Germany; Netherlands; Chile, Costa Rica, Colombia, and Mexico; global (literature review)	Renewable energy, wind energy, geothermal energy	[72], [73], [75], [82], [87]	8, 22, 23, 24

Table continued.

People are more willing to get involved if they perceive the engagement process as fair (Interviewees 8, 19) [31], [67], [70]–[72]. A fair process means that all affected groups of an infrastructure project can participate (procedural justice) and raise concerns and opinions [5], [73], [74]. For this to happen, all relevant stakeholder groups must be consulted, including hard-to-reach groups (such as young families, migrants, or Indigenous people) [5], [75]. One interviewee emphasized that the infrastructure should respond to the public:

> "What participation we should be doing is to enable energy infrastructures that are responsive to public concerns and values." (Interviewee 1)

Conversely, an experience or perception of unjust decision-making processes and distribution of impacts (distributional justice), can also motivate the public to get involved [76].

There are also different factors related to the *outcome* dimension of projects that drive participation.

Individuals and communities are motivated by the desire to achieve the best local solution that integrates seamlessly with their environment and contributes to a sustainable future (Interviewees 2, 6, 13). Communities may have existing visions for their community development, which they want to align with energy infrastructure developments [54]. Interviewee 7 emphasized:

> "You may not get the cheapest but the most sustainable projects." (Interviewee 7)

If this is not the case, the public might be more interested in engaging if the focus is on a longer-term vision of the community, rather than a single infrastructure piece (Interviewees 3, 4). Experts reported that instead of approaching communities with the topic of energy, they start by discussing broader issues and ideas around community development and resilience (Interviewees 3, 4). The public might also want to have a say in deciding about the investment into the energy infrastructure asset, particularly when the electricity pricing is linked to local generation (Interviewee 2).

Financial incentives and community benefits can also be a crucial driver of public participation [77], [78]. Experts stated that it is important that people benefit (financially) from the projects locally (Interviewees 2, 4, 6, 7, 11, 18, 22) or get compensated (Interviewee 19). Developers pay landowners to lease the land, so they are easy to get on the positive side (Interviewee 18). Financial participation can also be achieved, for example, by offering ownership opportunities or lower electricity prices for those living near the infrastructure (Interviewee 2).

> "[Company] has used public participation networks, which are linked to municipalities and counties, and one of the main areas of discussion has been around where there's funding, grants available to go for these groups to divide the expending. When the money is on the table, people get very interested." (Interviewee 11)

Therefore, public engagement in energy infrastructure can bring financial benefits to regions that may be economically weaker (Interviewee 7). For this, it is crucial that individual and

communal benefits are known, such as employment opportunities or compensation payments [30], [67], [72]. Jobs may not always be created directly in the renewable energy sector, but clean energy can be supplied to and support local businesses that employ local people (Interviewee 25).

Research suggests that some people want to engage in forms of local (co-)ownership to contribute their thoughts on the design and operation of projects and to decide how benefits are distributed [54], [65], [72], (Interviewees 2, 4, 7, 13, 23). For example, Maqbool et al. [79] analyzed how the energy cooperative Zeeuwind in the Netherlands gained the trust of the community by funding public monuments and a community center for the municipality. Some examples show that local ownership can be motivated by the availability of regulatory knowledge on how to set up an energy project, such as the dedicated support provided by the Sustainable Energy Authority of Ireland, as well as legal frameworks to ensure that energy communities have a clear legal status and business model [66].

People also value the sense of community that comes from a collective participation in energy infrastructure developments [65] (Interviewee 24).

> "OK, yes, you're thinking it's going to be a social activity then and it's social processes." (Interviewee 24)

Drivers of institutions/developers when engaging the public in energy infrastructure

There are several drivers associated with the *process* dimension of conducting public engagement.

Public participation must be made easy (Interviewee 2). One expert stressed that implementation of energy infrastructure highly depends on how it is socially organized (Interviewee 1). Thus, it is also important to consider how the public can participate and when (Interviewee 4). Publics may have different understandings of what level of participation is appropriate to them. “Don’t burn them down”, stated one expert (Interviewee 4). Thus, it is crucial to engage the public with the right intensity, the right methodology, at the right time (Interviewee 5).

Public participation can also be facilitated through early and ongoing invitations to citizens to participate. Early and continuous participation is crucial because it shows the public that they can influence the decision-making process (Interviewees 2, 6, 7, 8, 10, 12, 18, 19, 20, 23, 25), and it allows the diverse views and concerns of the public to be incorporated into decisions at an early stage [5], [39], [70], [80]. Using the example of transmission lines connecting offshore wind farms to the mainland in Germany, Ruiten et al. [19] showed that when developers see public participation as an important part of the process, they will even delegate decisions to the public. Experts emphasized that engagement must start with listening to the people and understanding their priorities and concerns (Interviewee 3, 7, 15). This can also legitimize the outcome of the project [19] and reduce chances of encountering significant objections later (Interviewee 2). For example, Corscadden et al. [30] found that most people want to be contacted once there is already an idea of the quantity and quality of the wind turbines to be installed, i.e., five turbines of the type X are proposed to be installed at location Y. However, one expert also emphasized that

public engagement should continue throughout the operation and maintenance of energy infrastructure (Interviewee 8).

Clear communication is crucial to enhance participation and social acceptance (Interviewees 2, 5, 12). There was a strong agreement that the “Why?” question is very important – in other words, explaining why certain infrastructure is required, why in certain areas (Interviewees 1, 5, 7, 9, 12, 15, 25), and what is at “stake” (Interviewees 3, 21, 20). Interview 12 explained:

> “There are long procedures for each project, so it’s important to have engagement not only after the project start, but also before to inform them why it is important and why the project is being done.” (Interviewee 12)

In addition, transparency about the development process (from the side of developers) can create and strengthen trust in the projects and developers (Interviewees 7, 12, 19, 25). Experts (18, 20, 25) also mentioned the growing challenge of fake news around energy infrastructure projects, which needs to be countered with clear, positive narratives about infrastructure projects, otherwise protest groups can take a hold of their narrative and “run away with it” (Interviewee 20).

Related to the former point, **a timely, transparent, consistent, and reliable provision of information from neutral parties about project developments can enhance participation** [39], [81]–[83]. The public should be informed about the relevance of certain technologies, which areas are suitable for energy generation projects, and what is planned to happen. This information allows the public to make informed decisions about concrete projects. In the context of a transmission project in Germany, Komendantova and Battaglini [58] wrote that “stakeholders expected information [is] to be provided early enough, when there is still an opportunity to change something, it should be honest and transparent about experience with similar projects in other places, include clarity about possible risks as well as its impacts on human health and environment” (p. 227).

While Lienert et al. [84] stressed that public engagement should be not understood as a way of educating the public, **raising awareness and building capacities for the public is crucial to create a shared understanding around energy infrastructure** [39], such as whether transmission lines are built to transport renewable or fossil electricity [58], or the description and purpose of Environmental Impact Assessments (EIA) [19]. Interviewee 25 emphasized also the role of universities and energy agencies in proving wider information about technological options; but even businesses get more actively involved in shaping the debate by informing about risks of electricity shortages for running their company.

Actors have different motives for public engagement and can positively support the processes. **A motivation of developers can be to harness the knowledge of the public so that better solutions can be achieved**, surpassing what could be accomplished by individual efforts alone (Interviewee 1). Local (Indigenous) knowledge can be crucial in making better-informed choices and supporting project developments [57], [62], [79], [85].

Local traditional or opinion leaders or “liaison” can also be important for receiving backing for local project developments. Interviewee 15 explained that they use the community "liaison" in Romania to "access" and be introduced to important people in the

community. Similarly, interviewee 7 from Ireland mentioned that it is important to establish relationships with representatives of local parishes or sport associations in order to understand the community dynamics and gain local trust. Batidzirai et al. [53] explained that for the case for rural electrification projects in Uganda and Zambia local chiefs must play a role in the development, otherwise there will be no development. They also stated that chiefs can also "act as mediators between developers and community representatives in the event of conflict" [53] (p. 5).

Additionally, higher engagement can be achieved if the engagement process is led by local people who have a deep understanding of the community and its needs (Interviewees 1, 2, 25). This is important as the public might mistrust the role of the local governments or project developers. Project developers are also increasingly looking for a regional presence through an office to be close to local developments (Interviewee 25). One interviewee reported from a wind energy company:

> "This wind energy company has hired its first employee in the very north of Sweden, letting the people know that we now have an office up here too. I know this is key." (Interviewee 25)

Additionally, experts also stressed the importance of local people and networks to inform and convince other people (Interviewee 7, 11).

Local politicians and authorities can also play an active role in supporting participation processes by setting requirements for local involvement in the planning process [54]. Interviewee 2 mentioned a successful example of wind power plants in Nijmegen, the Netherlands, where the municipality subsidized the public involvement process, leading to minimal objections. This approach of local authorities actively supporting engagement processes is not specific to energy projects but is a general mechanism observed in other types of infrastructure development as well, where early involvement of the public helps to reduce public opposition.

Public engagement outcomes can also be driven by private sector business interests. Public engagement can be understood as risk reduction measures for business. Interviewee 3 mentioned four major risks of energy infrastructure projects: technical feasibly, financial viability, environmental compatibility, and social support. They emphasized that if you get social support at the beginning, it is like an insurance (Interviewee 3). One interviewee added to that by saying:

> "It might be very tempting to skip the involvement of the citizens because all current processes do not take it into account, so it's always an extra effort to organize it. But on the long term, I think with increasing limitations in public space, with increasing costs for the energy transition with increasing discussions about security of supply […] you will only create your own slow complex process when you do not involve citizens from start." (Interviewee 22)

Interviewee 11 said that the fishing industry has a particular interest in understanding where an offshore project will be located and what the expected impacts will be. Thus, they demanded to be informed and consulted. Companies can also benefit from infrastructure projects by providing equipment, accommodation and food for workers (Interviewee 24).

The *policy context* can drive project developments, such as through shaping discourses, providing funding support, and defining engagement strategies [86].

Legal requirements imposed by regulatory authorities can enable public participation, as companies or developers are obliged to engage the public [72], [73], [75], [81], [87], (Interviewee 8, 22,23). Ntui and Rampedi [88] showed that environmental professionals were required to conduct an EIA for a solar photovoltaic project in the Mogogelo community in the Northwest Province of South Africa and that through this obligation traditional knowledge was used and heritage rights could be secured. For the case of geothermal energy in Latin America, Saldivia et al. [89] wrote that some countries have endorsed the International Labor Organization Indigenous and Tribal Peoples Convention, which emphasizes compliance with international social and environmental standards, including principles related to Indigenous consultation. Alternatively, many countries have introduced community funds to create benefits on the local level (see **Section 3.3**).

This leads to the question of whether more legally binding minimum requirements for public participation or more voluntary guidelines by developers are needed. One expert said that minimum requirements are important, but you cannot have “one size fits all” as realities on the ground vary (Interviewee 8). Another expert pointed to the need for action on the part of companies to ensure that strong principles of engagement are implemented (Interviewee 11).

3.2.2 Barriers of public engagement

The literature review and expert interviews identified common barriers that discourage public participation in energy infrastructure. The **Table 3** on pages 22-23 summarizes the barriers of public engagement.

Barriers of people to engage with energy infrastructure

An observed barrier is that the public does not know enough about how to participate in planning processes [59] (Interviewees 2, 6, 8). Even when citizens are aware, they are confronted with complex planning processes than can be overwhelming [90]. Project developers may not have communicated the engagement purpose clearly enough, and the public may be uncertain about their contribution to the process [69]. If people were more informed about the opportunities, they would potentially be more engaged.

However, **experts noted that not all people are interested in engaging with energy** because is not their top priority (Interviewees 3, 5) and it is hard to understand how they can benefit (Interviewee 25). It seems to be difficult to engage the public, specifically if they are not directly affected by a planned infrastructure project (Interviewee 12). Interviewee 25 reported a silent majority who thinks wind power is OK, but who are less inclined to engage in the debate than the opposing parties. In fact, there are no compelling reasons or adequate incentives to participate [5], [64]. One expert said that they had an informal saying: *“We work with the willing.”*, but they also recognized the need to address those who are less able to engage (Interviewee 4). In addition, if they have already had a bad experience with previous renewable energy infrastructure, this makes them less open to future projects [55].

Table 3: Barriers of public engagement in energy infrastructure based on the literature review and expert interviews.

Barrier	Type of barrier	Concerned actors	Found in what country context	Found for what technology	Literature references	Expert reference (interview number)
Unawareness of participation opportunities and purposes	Social-technical	Public	Netherlands, UK	Energy and transport infrastructure, geothermal energy	[59], [69], [90]	2, 6, 8
Lack of interest, lack of incentives	Socio-psychological, socio-economic	Public	Ireland, Switzerland, UK	Energy transition		3, 5, 25
Time and resource intensity of processes	Socio-psychological, institutional	Public	Denmark, Germany, UK, USA	Wind energy, transmission grids, energy transition	[58], [74], [91]	6
Limited awareness and knowledge about energy infrastructure and its development	Socio-technical	Public	Global reviews, EU, Germany, India, Netherlands, Romania	Green hydrogen, onshore wind, Transmission grids, biogas, solar micro-grid	[5], [55], [66]	4, 7, 9, 11, 15, 16, 22,24, 25
Mobilization by anti-renewables movements	Socio-psychological	Public				6, 18, 24, 25
No decision-making power and autonomy	Social-psychological	Public	Canada, Denmark, England, global literature review	Wind energy	[72], [87], [91], [95]	
Lack of trust in developers and local governments	Social-psychological	Public, developers	Denmark, UK / England, Germany, Netherlands Norway, USA, global literature review	Wind energy, electricity grids, energy transition	[20], [58], [64], [72], [94], [95], [97]-[99]	4, 12, 15, 25
Limited early and continued invitation to participate	Institutional	Developers	Chile, Costa Rica, Colombia, and Mexico; South Africa; 13 country review	Geothermal energy, hydro energy, wind energy	[18], [89], [100]	
Insufficient knowledge and consideration of citizens values, identified, preferences	Socio-technical, institutional	Developers, governments	Denmark, Netherlands, India, Uganda and Zambia, Malawi and South Africa	Wind energy, geothermal energy, rural electrification, bioethanol / biogas	[55], [71], [92], [102]	1, 3, 7, 8, 11
Limited value and resources placed on engagement	Socio-psychological, institutional	Developers	Belgium, Denmark, Ireland, Netherlands, Uganda and Zambia,	Transmission grids, rural electrification, district heating	[19], [53], [105]	11, 18, 19
Lack of internal capacity	Institutional	Developers	Ireland, UK	Grids	[94]	11, 18

Existing power relations	Institutional	Public, developers, governments	Review of 93 articles	Renewable energy	[32]	
Lack of practice and instrumentalization	Socio-psychological, institutional	Developers	15 case studies review; Chile, Costa Rica, Colombia, and Mexico; UK, Ireland	Renewable energy, storage mainly related to solar; geothermal energy	[105]	1, 11
Lack of understanding about engagement preferences	Socio-psychological, institutional	Public, developers, governments	Uganda and Zambia; review of 13 countries	Rural electrification, wind farms	[53]	
Lack of understanding about the importance of the social dimension of energy infrastructure	Socio-technical, Institutional	Developers, governments	Germany, India	Onshore wind, biogas, solar micro-grid	[55], [107]	3, 11, 13, 15, 21, 23
Missing or complex legal frameworks	Legal	Governments, developers	Denmark, Netherlands; UK; Uganda and Zambia; Chile, Costa Rica, Colombia, and Mexico	Energy and transport infrastructure, rural electrification, geothermal energy, regional energy strategy	[53], [59], [89], [108]	5, 7, 8, 19
Legal and financial constraints	Institutional	Developers, public	Denmark, Netherland, Ireland	Wind energy, grids	[91]	2, 7, 22
No institutionalization of participation	Institutional	Developers governments	Germany, Ireland, Uganda and Zambia	Energy transition, wind energy, rural electrification	[71]	7

Table continued.

There are different hurdles related to the *process* of public engagement.

Public engagement is also constrained by the fact that such processes are time- and resource-intensive and may discourage people from actively participating [58], [74], [91]. Retired people are often very interested because they have the time and other resources (Interviewee 6, 21). It is important to recognize that energy infrastructure developments can take many years, and in the meantime, public expectations and aspirations can evolve and change significantly. One interviewee talked about a wind turbined project in the North of Sweden:

> "10 years ago, Northern light tourism did not exist there. But our project periods are very long. […] The community has been very positive to the new tourism. […] And now the project will be turned down. […] We did not have the possibility to respond to this. […] It is not easy to keep the contact and be alert if you are not present in the community." (Interviewee 18)

This dynamic nature of the processes makes it particularly challenging to engage and address specific concerns and needs (Interviewee 18). Thus, determining the scope and right timing of participatory processes can be challenging [92].

Additionally, people have limited awareness and knowledge about energy infrastructure and its development [5], [55], [66]. Infrastructure projects are technically complex [74] (Interviewee 22), making it difficult for the public to understand technologies [93] and their implications and investment opportunities [72]. Langer et al. [31] wrote 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). Experts also emphasized that sometimes people do not understand the energy infrastructure project or their benefits (Interviewee 4, 9, 11, 16, 25). Interview 15 reported for a carbon capture and storage project:

> "It is very little known and understood in the public about how carbon is stored underground. […] We assumed to handle it like any other project. But they (the people) had questions and we had to deal with negative information and ideas that are already there." (Interviewee 15)

The complexity of projects also leads to the fact that some groups contest the need for technologies, as such overhead lines and grids, as a whole [94]. For example, a local community in Germany protested against a transmission grid project because they questioned the need for the specific line 'Sued.Link' [58].

Resistance and public mobilization from certain groups can hinder effective public engagement in participation processes and halt overall infrastructure development (Interviewees 6, 18, 24 25). For example, one expert described how people in Sweden are reluctant to take sides and speak out for or against wind turbines.

> "Quite simply, the resistance became so incredibly well organized, the national resistance. So, that you have gone around to these consultation meetings and actual created confrontation. In many

> ways this means that people don't dare to ask things and don't dare or don't want to end up on one side or the other." (Interviewee 24)

The public is not interested in participating in processes if they believe that they cannot influence the process because decisions have already been made [72], [87], [91], [95]. In such a case, participation can be perceived as a legitimation process, "intransparent, inscrutable, or even corrupt" [89], "therapy" [71], or even "bribery" [18]. Aitken [63] showed for wind power development in Scotland that the public was restricted in the issues they could raise during the public inquiry: "The role of public participants was severely restricted by norms and expectations of 'acceptable' evidence within the inquiry. […] This can be viewed as a clear exercise of agenda-setting power, and a means of setting limits to public participation" (p. 257). A lack of meaningful and timely opportunity to influence the quality and substance of the decision in renewable energy can lead to public skepticism, mistrust, frustration and opposition [57]. Several experts reported resistance to energy infrastructure projects and even a sense of exploitation by affected citizens (Interviewee 24).

Barriers of institutions/developers that engage the public in energy infrastructure

There are several barriers resulting from preconditions.

Lack of trust between citizens and developers is an important barrier to public engagement [20], [58], [72], [94], [95]. Ceglarz et al. [96] describe a lack of trust in Transmission System Operators (TSOs) due to their public perception as large corporations that often do not listen to people. Whether true or not, complaints and opposition can lead to uncertainties and delays and hinder public engagement [91]. In the Netherlands, Koelman et al. [20] found that lack of trust resulted in a minority of landowners not participating in the debates and merely accepting the decision. Experts also confirmed the lack of trust as a barrier to public participation (Interviewee 4, 12).

> "To create trust, you have to be transparent, open-minded, have to go on site, talk to the local communities, engage with different perspectives." (Interviewee 12)

One interviewee (15) stated that it is important to look at a company's historical presence in the area to know about existing or historical relationships between energy companies and the people.

A lack of trust and limited confidence in their decision-making processes is also found in local governments [64], [97]–[99] (Interviewee 25). One interviewee (15) reported that citizens were unhappy with the majority of the community supporting the planned projects, so they had to rebuild trust with the community to build confidence in the project. This can lead to reluctance or resistance to participate in local government-led initiatives. In fact, the people who design and implement participatory processes can control who participates [87] and influence the final outcomes [71], which can lead to the public perceptions that meetings are formalities [87]. Ernst and Fuchs [71] describe this as "choices and motivations of decision-makers and representatives of the administration predetermine the potential for and outcomes of participatory governance" (p. 2).

Other barriers are related to the *process* of public participation.

In practice, companies often do not invite the public to participate in the early stages of a project, and do not do so with the same level of effort over time [18], [89]. Public participation may be even a reactive measure to resolve conflicts that arise during the planning and approval phases [100]. For example, the bankruptcy of a solar energy company in China led to conflicts among residents over the project, triggering a defensive public involvement [101]. In the Netherlands, protests against a transmission line led to the suspension of the project, allowing local stakeholders to propose alternative routes [19]. Less participation is observed in later stages of the technology life cycle, such as operation, maintenance and decommissioning or repowering [18].

A key barrier to and potential failure of public engagement is the insufficient knowledge and consideration by key actors of citizens' values, identities, priorities and technology preferences [71], [92], (Interviewees 1,3,7,8,11). Pandey and Sharma [55] presented the case of Punjab in India, where the government had ambitious plans to promote the bioethanol industry by burning rice straw from farmers in industrial plants. However, the process failed because neither the government nor the industry actors took into account the farmers' perspectives and the symbolic value of straw burning, so the farmers continued with conventional straw burning as an expression of protest. This illustrates the risk of treating the public as a homogeneous group whose needs are not sufficiently considered or generalized [55]. Similarly, Kalina et al. [102] found that a lack of public engagement in biogas projects in Malawi and South Africa led to the failure of the biogas sector: "[...] engagement with owners, financiers and providers has suggested that the interplay and relationship between these three stakeholders is a key determinant of project success or failure, with the owner being the most important facto" (p. 3). Last, Pandey et al. [103] analyzed solar microgrid projects in India and found a misconception on the part of the industry that villagers were "customers in waiting", while "the majority of farmers and agricultural workers did not see the solar grid as a solution to their energy poverty and a means to meet their energy needs" (p. 2).

This is due to the limited value and resources placed on public engagement and understanding public opinion [19], [53]. Promoters and developers see the public too often as the problem – with a lack of technical expertise and strategic view [104] (Interviewee 1). Jami and Walsh [80] stressed that "perception[s] must shift from the dominant view of the public as 'a risk to be managed' towards 'a resource that can be tapped'" (p. 1). Batidzirai et al. [53] found that only one-third of households surveyed in Uganda and Zambia reported having discussed their needs with energy companies, and only half of respondents reported having been consulted in the planning of an electricity system. In the context of a transmission network project in the Netherlands, Porsius et al. [61] experienced "quite some pushback whenever we argued for more participatory space, and new proposals were often met with a list of barriers and impossibilities. One of the reasons, we believe, is institutionalized fear of resistance and delays, a lack of faith in the valuable outcomes of participation, and the possibility of the exception becoming the rule, thereby changing routinized ways of working" (p. 10).

If corporate departments perceive public engagement as unnecessary, it makes it difficult for responsible staff to get approval for cost recovery or for actions that involve co-designing decisions with the public [19]. Thus, management support and a public-facing corporate

strategy were highlighted as crucial to implementing more participatory and inclusive approaches (Interviewees 3, 11, 20). As one expert emphasized, public engagement needs to be part of a company's DNA (interviewee 8). This also implies that adequate resources need to be allocated to public engagement.

Another barrier is a lack of practice and instrumentalization of participation among project promoters and developers (Interviewees 1, 11). Interviewee 1 warned that public participation is sometimes instrumentalized and that it is crucial to ask whose interests are being served. As a result, there may be a lack of political support or financial resources to implement state-of-the-art engagement processes [105]. Given the opposition-related delays or project cancellations reported in the realization of projects, such as the transmission network project, developers are beginning to recognize that their projects will move faster if they involve the public (Interviewees 8, 11, 12). One interviewee stated:

> "[…] projects have been delayed for many, many years […]. So, when we investigated the reason behind all of this, it became very apparent that it was through a lack of public engagement and a lack of consultation or meaningful participation from citizens in the process". (Interviewee 7)

A lack of engagement is also caused by a lack of internal capacity among project developers to conduct meaningful stakeholder engagement [94]. Public engagement requires significant human and financial resources from the mapping of actors to their effective engagement (Interviewee 11, 18). As Interviewee 11 explained:

> "I think there was a lack of resources put into explaining the impacts and the projects to the local communities. Arguments around noise or flicker and other adverse impacts was not completely true. Which could be understood as people did not want that infrastructure there." (Interviewee 11)

Thus, requirements for public engagement may be seen as challenging, or even as obstacles by generators, utility companies and governments [65], [89]. Interestingly, the interviews also revealed differences in public engagement expertise across technologies: governments and companies seem to have experts focused on onshore wind, offshore wind, grid development, or carbon capture and storage, while there are no dedicated experts for large-scale solar PV or biogas projects, for example. One expert (20) emphasized that they have a dedicated team that manages offshore relationships because they are very different to onshore stakeholders and that they do a lot of upskilling and in-house training.

There may be a lack of openness among practitioners to change existing ways of engaging the public in energy infrastructure. Public involvement in energy infrastructure challenges existing predefined power relations and participation structures. Community control of energy requires new forms of governance and power relations that may not be accepted [32]. As a result, the public may choose non-participation as a mode of resistance against pre-defined roles and identities assigned to them in renewable energy projects and mobilize their agency [106].

A related barrier is also the lack of understanding of how the public wants to be engaged. Batidzirai et al. [53] found a significant gap between community preferences for

needs-based engagement and how the public and private sectors currently engage: 30% of respondents are engaged compared to 93% who expressed a strong desire to be involved in the planning and implementation of electricity initiatives. The different preferences for the level of public engagement were also confirmed by a study on wind energy in 13 countries and different stakeholders, including administrative bodies, project developers, environmental organizations, financial institutions and cooperatives. Wesche et found that respondents were more in favor of information and consultation activities – while surveys of the public showed a preference for deeper public engagement (see Section 3.1.1).

Experts also noted that there is still a lack of understanding among decision-makers about the importance of the social dimension of energy infrastructure projects. Infrastructure projects are too much treated as technical or economic issue [55], [107] (Interviewee 3, 11, 13, 15, 21, 23) and neglect for example value-based arguments [95]. Interviewee 11 explained the challenge of the intangibility of factors such as sense of ownership, community identity or belonging, and place attachment. Specifically in relation to the EIA, place attachment, cultural landscape values and quality of life are not considered legitimate for analysis [95]. The limited scope of the discussion may also prevent the public from discussing broader concerns with projects [85]. Nevertheless, there seems to be a growing interest in energy infrastructure within the government, as it has been observed that projects have been blocked due to insufficient public participation (Interviewee 5).

The study furthermore identified barriers stemming from policymaking.

Missing or complex legal frameworks for participation in the planning process can hinder participation [53], [59], [89], [108], (Interviewee 19). National governments often have loosely formulated participatory ambitions or procedural requirements [81], [89] (Interviewee 11). Except for some community benefits that are guaranteed to local people, public engagement is often not institutionalized (Interviewee 7). As Interviewee 5 stated:

> "The challenge of principles is that they are easy fluffy words to publish, but then you need buy-in to enforce them." (Interviewee 5)

This issue leaves many details of engagement to the project developers. Thus, even if national policy guidelines have high ambitions, actual practices may fall short [81]. This can lead to stakeholders not appreciating participatory processes [92], or to such processes not meeting their expectations, with detrimental effects on social acceptance [67].

Experts also reported that legal and financial factors are often major obstacles to projects (Interviewees 2, 7). They acknowledged that legal obstacles need to be overcome, for example to make preferred ownership of energy infrastructure a reality (Interviewee 1). For a wind energy project in Denmark, Elkjær and Horst [91] explained that the association's preferred model of unilaterally owning and developing part of the project faced legal barriers and was not approved by the responsible ministry. One interviewee (Interviewee 2) believed that this aspect could be improved by offering stable energy prices directly linked to the local generation plant. Currently, "distant consumers" receive energy from the grid and are subject to market prices influenced by geopolitics, which weakens their link to local generation. By establishing a direct link between electricity prices and local generation, they believe that the public would have a better understanding of the importance and impact of generation assets, leading to increased engagement. Therefore, there is a need to update regulations and create legal frameworks to encourage public participation in energy

infrastructure projects (Interviewee 2, 7). This requires governance requirements that ensure legal and planning certainty and social cohesion [67]. It also requires continued policies (Interviewee 4).

Non-institutionalized participatory measures are a key barrier to participation. There may even be conflicting rationalities among facilitators, decision-makers, public authorities, and citizens [71]. Although different conventional and unconventional forms of citizen participation are implemented at different scales, people in rural areas have often been excluded from citizens dialogues, or citizen summits [107]. Fraune and Knoth [107] argued that inconsistent implementation of participation methods and forms is a major threat to the legitimacy of planning and decision-making processes within the German energy transition.

3.3 Mandatory and voluntary requirements for public engagement in energy infrastructure

Legal and institutional frameworks can motivate public engagement [109], influence opportunities for public engagement [21] and limit the scope of public input [74] in energy infrastructure projects. Public engagement can be facilitated through two distinct approaches: voluntary initiatives and guidelines, as well as mandatory rules and regulations.

3.3.1 Voluntary Initiatives and Guidelines on Public Engagement in Energy Infrastructure

Voluntary initiatives and guidelines play a pivotal role in proactive efforts by stakeholders to encourage and facilitate public participation in energy infrastructure projects. These initiatives and guidelines go beyond legal requirements and aim to promote trust, transparency, and inclusiveness (**Table 4** on pages 30-31). A good example of voluntary initiatives is community benefits schemes in Ireland. These schemes are integral to renewable energy developments, fostering positive relationships between businesses and communities. These voluntary arrangements offer benefits near developments and were endorsed by the Scottish Government [110]. This approach demonstrates the wider recognition of such principles. Incorporating these insights into voluntary initiatives demonstrates commitment to responsible energy development. Moreover, community benefit schemes are not a material consideration in planning applications but have been widely adopted and serve as a benchmark for the sector. However, one interviewee also emphasized that there is a risk that it can be seen as bribery (Interviewee 8).

Recognizing that many voluntary programs require more than isolated efforts, it's important to emphasize the essential organizational and coordinating functions that agencies undertake to ensure the success of these initiatives. These include gathering information, shaping the development of comprehensive guidelines and standards, and ensuring performance metrics. Guidelines and standards are not just documents; they are critical tools that streamline public engagement, provide a structured framework for activities such as community consultation, and enhance transparency and inclusiveness. By combining well-structured policies with robust organizational functions, developers and governing bodies can create a comprehensive framework that empowers communities and effectively engages stakeholders. Through these collaborative efforts, energy projects evolve as informed, inclusive efforts that prioritize the interests and concerns of all stakeholders.

For example, ThEGA, Thuringia's energy agency in Germany, launched the "Fair Partners for Wind Energy" program [111]. Its five guidelines include a commitment to develop opportunities for direct financial participation by citizens, businesses and communities in Thuringia. Developers who comply with the agency's guidelines receive certification and commit to involving citizens, businesses and communities directly in financing. This ensures that citizens have a "direct" role. Thuringia's approach awards the "Fair Partner" seal for one year and helps communities identify trustworthy partners. About ninety developers have been informed, resulting in thirty inquiries and fourteen certifications, including two citizen-owned energy cooperatives. This promotes inclusiveness in responsible energy development.

Table 4: Voluntary Initiatives and Guidelines on Public Engagement in Energy Infrastructure

Countries	Voluntary Initiatives and Guidelines on Public Engagement in Energy Infrastructure
Australia (Victoria State)	**Minimum Requirements for Victorian Renewable Energy Target Auction Eligibility**: criteria that renewable energy projects must meet to participate in government auctions for contracts [112]: ▪ Work directly with the community throughout all stages of the project ▪ Ensure community concerns and aspirations are consistently understood and considered, and directly reflected in the alternatives developed. ▪ Provide feedback on how input influenced the decision. **Community Benefit Sharing:** ensuring local communities' benefit from energy projects, through financial contributions or other benefits [112].
Germany	"**Fair Wind Energy"** in the federal state of Thuringia [111] ▪ Voluntary guidelines for wind projects. ▪ Developers prioritize cooperation and transparency, involving local communities and stakeholders. ▪ Emphasizing collaboration for a sustainable energy landscape in Thüringen.
Ireland	Projects of Common Interest Manual of Permit Granting Process Procedures Article 9 of Regulation 347/2013 on **Guidelines for Trans-European Energy Infrastructure** [113]. ▪ Chapter 3 on public participation (based on Aarhus Convention): • Irish laws mandate public consultation for projects or licences. • Notice must be given in local/national newspapers before application submission • Weekly updates on decisions are published by the authorities. • In general, the public may participate in consent processes in the following ways: (a) Submissions/observations at application stage, (b) Submissions/observations at appeal stage, (c) Comments on an environmental impact assessment report, (d) Comments on a Natura impact statement, (e) Participation in an oral hearing, (f) Judicial review of decision. **Eirgrid community benefit fund:** "a dedicated fund for new grid development is made available to provide direct benefits to communities who are closest to new transmission infrastructure." [114]
Netherlands and Belgium	The **Citizen Participation Playbook** [115]: ▪ Developed by OECD, Interreg V Flanders-The Netherlands, and DG REGIO ▪ Aims to boost citizen involvement in cohesion policy ▪ Guide for Interreg Flanders-the Netherlands program ▪ Incorporates citizen participation in project phases including planning, design, implementation, and evaluation ▪ Helps determine suitable times for citizen participation ▪ Offers process structuring, quality assurance, and follow-up ▪ Provides methods and tools for specific purposes and contexts
Sweden	Stakeholder participation is often recommended by national and regional authorities.
United Kingdom	Net Zero Strategy: build back greener (2021) [115] Chapter 4vi: Empowering the Public and Business to Make Green Choices: Moving towards a net zero society together.

	6 Principles underpinning green public and business choices. ▪ Principle 1 - Minimise the 'ask' from the public by 'sending clear regulatory signals.' ▪ Principle 2 – Make the green choice the easiest. ▪ Principle 3 – Make the green choice affordable. ▪ Principle 4 – Empower people and businesses to make their own choice. ▪ Principle 5 – Motivate & build public acceptability for major changes. ▪ Principle 6 – Present a clear vision of how we will get to net zero and what the role of people and business will be. Powering Up Britain: Net Zero Growth Plan Chapter: Empowering the Public and Business to Make Green Choices (2023) [116] ▪ Government plans to enhance public engagement on net zero, supporting awareness, roadmap development, and net zero messaging. **Consultation on community benefits** for electricity transmission network infrastructure (2023) ▪ to create voluntary guidance for industry and communities when developing individual community benefit packages. ▪ This guidance will cover how to deliver direct benefits payments to eligible individuals and wider community benefits. ▪ Recommend establishing a recommended level of funding for community benefits in agreement with Ofgem." **Scotland:** ▪ Good Practice Principles for Community Benefits from onshore renewable energy developments [110]

3.3.2 Rules and Regulations (Mandatory) on Public Engagement in Energy Infrastructure

Mandatory regulations and rules function as binding legal instruments that require developers and regulatory authorities to engage the public in energy infrastructure projects (**Table 5** on page 33-34).

The United Nations Economic Commission for Europe (UNECE) Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (Aarhus Convention) [117] considers access to environmental information and public participation in decision-making on specific activities as a right of every person. Under the general provision, each Party shall take measures to achieve the objective, including:

> "Each Party shall endeavour to ensure that officials and authorities assist and provide guidance to the public in seeking access to information, in facilitating participation in decision-making and in seeking access to justice in environmental matters." [118]
>
> "Each Party shall promote environmental education and environmental awareness among the public, especially on how to obtain access to information, to participate in decision-making and to obtain access to justice in environmental matters." [118]

The United Kingdom, the Netherlands, Ireland, Sweden and Switzerland are among the 47 countries that have signed the Aarhus Convention.

At the European level, Directive 2011/92/EU [119] provides a legal framework for the assessment of the environmental impacts of certain public and private projects. This legal framework emphasizes the importance of effective public participation in the decision-making process for such projects.

> "Effective public participation in the taking of decisions enables the public to express, and the decision-maker to take account of, opinions and concerns which may be relevant to those decisions, thereby increasing the accountability and transparency of the decision-making process and contributing to public awareness of environmental issues and support for the decisions taken." [119]
>
> "Participation, including participation by associations, organization and groups, in particular non-governmental organizations promoting environmental protection, should accordingly be fostered, including, inter alia, by promoting environmental education of the public." [119]

In addition, the Regulation (EU) 2022/869 [120] provides guidelines for trans-European energy infrastructure to ensure the timely development and interoperability of the priority corridors and areas of trans-European energy infrastructure. The Regulation underlines the importance of stakeholder participation in order to facilitate the timely implementation of projects of common interest.

> “Despite the existence of established standards ensuring the participation of the public in environmental decision-making procedures, which apply fully to projects of common interest, additional measures are still required under this Regulation to ensure the highest possible standards of transparency and public participation in all relevant issues in the permit granting process for projects of common interest.” [120]

Article 9, on transparency and public participation, requires project promoters to submit a public participation concept, to summarize the results of public participation in a report, and to provide a dedicated website with information on the project of common interest [120].

In many countries, project developers are required to conduct EIAs with public consultations [62], [89], [121], ensuring thorough evaluation of potential environmental, social, and economic impacts, as well as addressing public concerns. Specific regulatory frameworks mandate public hearings and consultations during project planning and approval stages, allowing affected communities to voice opinions and raise objections. Developers are compelled to provide comprehensive project details and potential impacts to the public through various communication channels, as well as creating public records of decision-making to ensure transparency and accountability.

Governments have also adopted regulations to define community ownership and benefits in energy infrastructure projects. One interviewee reported that the provision of community benefits is currently under discussion in Sweden:

> “We had an investigation going on from the government in Sweden so see whether we could also have some sort of regulation towards the municipalities because they don’t receive anything from the government or from us. Because many people ask: “What is in for us?”, “Why should we”?”. […] The results of the investigation were presented in spring and now we will see, if the government thinks, it is a good solution. (Interviewee 18)

Table 5: Specific Rules and Regulations (Mandatory) on Public Engagement in Energy Infrastructure

Organization/ Countries	Specific Rules and Regulations (Mandatory) on Public Engagement in Energy Infrastructure
United Nations	Aarhus Convention (1998): **Convention on Access to Information, Public Participation in Decision-Making, and Access to Justice in Environmental Matters.** Objectives: (a) Guarantee the rights of access to information, (b) Guarantee the right of public participation in decision-making, (c) Guarantee the right of access to justice in environmental matters [118]
European Union	Directive 2011/92/EU dealing with the **assessment of the environmental impacts of certain public and private projects** defines Environmental Impact Assessment (EIA) procedure [119]. Regulation (EU) 2022/869 (specifically Art. 9) provides **guidelines for trans-European energy infrastructure**, which underlines the importance of stakeholder participation to facilitate the timely implementation of projects of common interest [120].
Canada	**Consultation and engagement:** The Canada Energy Regulator (CER) manages Canada's energy infrastructure lifecycle. The CER Act changes project assessments with early planning, Indigenous engagement, and more public involvement [29], [122]. **Canadian Environmental Assessment (EA) Act:** EA aims to engage the community in addressing potential environmental impacts. Its purpose is to not only gather local environmental knowledge but also foster mutual support between the public and project developers [29].
Denmark	Denmark's Planning Act of 2018 mandates **citizen involvement in wind energy projects** [36]. ▪ In the "idea phase," citizens participate in strategic planning for wind energy projects in a specific area. ▪ In the "planning phase," public consultation is required for specific wind energy projects in chosen locations. ▪ The Act aims to ensure transparency and inclusivity in decision-making for wind energy projects. The Danish Promotion of Renewable Energy Act (2009) regulations for **consumer ownership in renewable energy projects** [123]: ▪ In nearshore tenders, the act mandates that 20 percent of ownership shares must be offered to local citizens. ▪ The act includes a special regulation for offshore demonstration projects, which ensures a guaranteed level of support. ▪ For onshore wind turbines at least 25m in height, or offshore wind turbines established without a tendering procedure, the owner must offer at least 20 percent of the ownership shares for sale to eligible individuals according to section 15 of the act. The Act also regulates the **compensation of the loss (offshore wind)** [123]: ▪ Compensation is granted if the establishment of an offshore wind farm leads to operating losses for owners of existing offshore wind turbines nearby. ▪ The compensation sum is imposed on Energinet.dk, the state-owned operator of the electricity and natural gas transmission system in Denmark.
Germany	**Citizen and community participation law** (2016) in the federal state of Mecklenburg Western Pomerania [124]: ▪ Obligation: Requires involvement of residents and communities close to wind farm sites. ▪ Wind Farms: Permissible in principle when residents and communities are included in the process. **Grid planning under the Energy Industry Law (EnWG), and Grid Expansion Acceleration Law (NABEG)** [125]: ▪ Accelerate power grid extension and transition to renewables; ▪ Reformed grid planning to accommodate renewable energy sources; ▪ Sought public involvement early in the process due to potential opposition to new power lines; ▪ Introduced fixed timelines for permit procedures; ▪ Short timeframes for public participation.
Ireland	**Community benefit fund** in "Terms and Conditions for the First Offshore Wind RESS Competition ORESS 1": The Fund aims to benefit the local community, and funding distribution, transparency, and use are carefully regulated, contributing to community well-being and renewable energy support [126].

Netherlands	The Dutch climate agreement (2019) [127] defines: **Process participation:** ▪ Public authorities are primarily responsible for communicating the importance of the energy transition. ▪ Participation guidelines will be developed under the Green Deal on Participation of the Community in Sustainable Energy Projects and the national RES program. ▪ These guidelines will provide tools for a participatory approach. ▪ The guidelines can be integrated into sectoral codes of conduct and spatial frameworks, such as environmental strategies, plans, and project decisions. **Environmental participation:** ▪ Project initiators determine the best participation methods from options like process participation, financial involvement, ownership participation, and more. ▪ The competent authority ensures initiators engage in community dialogue on participation aspects. ▪ Participation guidelines under the Green Deal on Participation identify potential instruments. ▪ Commitments with the community are documented in an environmental agreement. ▪ A project plan optimizes participation within the project.
United Kingdom	The UK Government's Localism Act in 2011 defined the **active participation of neighborhoods in planning** [128]: ▪ Localism Act emphasizes community participation in planning decisions. ▪ Focuses on nationally significant infrastructure projects like major train lines and power stations. ▪ Aims to maintain or improve the speed of major planning decisions. The UK Planning Act 2008 [129] and the recently constituted Infrastructure Planning Commission (IPC) [130]: ▪ Introduced changes to the governance of the transmission network. ▪ The new regime emphasizes **consistent public engagement in the planning process**.

Table continued.

3.3.3 Diverse approaches to public engagement: prioritizing throughout the process or by outcomes?

Both mandatory requirements and voluntary guidelines are established depending on the country/region and energy infrastructure, with most requirements for wind and transmission networks. Different countries take different approaches to public involvement in projects, with some emphasizing involvement throughout the process and others prioritizing involvement in project outcomes. The UK, for example, places a strong emphasis on public involvement in onshore wind projects through its Principles for Public Involvement. This allows citizens to express preferences and concerns in the decision-making and planning stages, with the aim of building more inclusive and well-designed infrastructure projects that meet the needs of the community.

The German Federal State of Mecklenburg Western Pomerania has taken a proactive approach to involving residents and communities by enacting the "Citizen and Community Participation Act." This Act obligates project developers to engage closely with residents living near the project site to ensure their voices are heard and their interests are considered. By actively involving the affected communities, the state aims to build a stronger sense of ownership and support for projects, fostering a positive relationship between stakeholders and facilitating smoother project implementation.

In contrast, some countries prioritize engagement in the project outcomes and seek to directly benefit the community affected by the renewable energy projects. In Ireland, the "Terms and Conditions for the First Offshore Wind RESS Competition ORESS 1" places a strong emphasis on community benefits. This initiative, known as "Community Aspects",

aims to establish a community benefit fund that can improve local infrastructure, support community initiatives, and promote economic development in the vicinity of the renewable energy project. By returning benefits directly to the community, Ireland aims to ensure that renewable energy projects make a positive contribution to the local economy and the overall wellbeing of residents.

Meanwhile, Denmark's Renewable Energy Act takes a unique approach by providing compensation for property owners who experience a loss in property value due to the proximity of renewable energy installations. This compensation mechanism helps to mitigate potential negative impacts on property values and addresses the concerns of affected citizens, fostering a more amicable relationship between renewable energy development and local residents.

The Netherlands illustrates a comprehensive approach to public participation in renewable energy projects, focusing on both process and results. The Dutch Climate Change Agreement and related guidelines highlight the importance of public participation in the energy transition process. The Netherlands takes a process approach to public participation through the development of participation guidelines under initiatives such as the Green Deal on Community Participation in Sustainable Energy Projects and the National Renewable Energy Program. These guidelines detail the structured methods and steps for involving the public in decision-making processes related to sustainable energy projects. Environmental participation involves commitments between project initiators and communities that form the basis for structured participation within projects. It emphasizes the involvement of project proponents in community dialogues to determine the best methods of engagement. This includes considering options such as process participation, financial participation, and ownership participation. One of the goals is balanced ownership in the regions, with a target of 50% ownership of local renewable energy production within the community. Local development funds provide opportunities for participation, with the local community deciding on their use. Various organizations are working to identify best practices for inclusive participation in the energy transition, to be integrated into renewable energy sources and project development.

Overall, these different frameworks demonstrate how different countries prioritize and incorporate citizen participation to create more sustainable and community-centered renewable energy development projects. While some countries focus on participation throughout the process, others focus on project outcomes, reflecting different rationales and goals. For example, Armeni and Anker [95] found that “[…] legal frameworks in England and Denmark, in general, reflect a procedural rationale for participation, framing it as a condition for the democratic legitimacy of the decision-making process. In the case of wind energy projects, participation is also often justified as a way to reduce opposition and catalyze acceptance of the developments, implementing an instrumental rationale for participation" (p. 853). By combining different strategies and learning from each other's experiences, countries can foster a global culture of inclusiveness and cooperation in the pursuit of a greener future.

3.4 Formats and methods of public engagement

Different formats and methods can facilitate public engagement processes. The literature review and interviewees revealed a strong focus on participation by local citizens and communities at different levels (informing, consulting, empowering) and in different formats and methods, ranging from information campaigns, surveys, negotiations, and deliberative processes. This section provides an overview of the different forms or methods according to the literature reviewed and the interviews conducted.

3.4.1 Participants and organizers of public engagement processes

A critical question of public engagement is who should be included in the decision-making process [38]. Chilvers et al. [24] emphasized the importance of a systemic mapping of actors to understand diverse public views and reveal unrecognized or excluded spaces for participation.

In most cases reviewed, local stakeholders affected by the proposed energy infrastructure are involved in the review of energy infrastructure projects. However, the involvement of all relevant stakeholders, including non-governmental organizations and business, is very important, otherwise concerns may not be addressed (Interviewee 12, 18). Komendantova and Battaglini [58] stated: "Concerns about the transparency of the decision-making process were only partly addressed; this is maybe due to the fact that local politicians and government representatives did not take part at the information events" [58] (p. 228-229). According to interviewee 1, it has been easier to engage those living near generation facilities such as wind or solar farms, while it has been challenging to engage the public living farther away.

The public involvement may vary depending on the phase of the project. In the permitting phase, local, regional or national authorities are usually involved, while in the spatial planning and siting phases, residents and local communities are involved [57], [131]. Landowners living near the project area are the most commonly reported stakeholders.

Apart from local actors, other actors can also be involved in the engagement process. These include non-governmental organizations [94], [96], local and regional authorities [76], [105]; and local groups [94], [96], [131]–[133], such as farmers [134], [135], unions [136], housing associations [137], and other local communities [39], [94], [138]. In some cases, federal ministries were also among stakeholders involved [20], [102]. Lastly, media was also involved in communicating with involved stakeholders, as well as by the public to bring awareness to their perspectives [96], [136].

The expert interviews also discussed several issues related to the inclusiveness of public engagement processes. It implies an open invitation of participants, the accessibility of the place and the diversity of communication formats, considering different types of disabilities (Interviewee 18, 21). While experts agreed that the aim is to be inclusive, it was also clear that in practice it is difficult to include everyone. Interviewee 3 shared the experience that the majority does not care (85%), 15% care and 5% really care – and thus, that they engage the minority. Adding to that, one interview emphasized that people should have the option to participate but asked: “Do you have to engage them if they don’t want? […] I don’t feel everyone needs to engage” (Interviewee 5). The choice of methods also determines who you reach and "what people will say or may not say" (Interviewee 1).

> "All forms of participation are all inclusionary and exclusionary in certain ways, you will also exclude certain public, certain framing, certain views." (Interviewee 1)

Even when discussing more participatory methods, the question of who should be involved was also raised by Interviewee 7, who added that the range of participants within a community forum could be different at different stages of project development.

> "So you recruit people initially and as the project options progress, you change the membership. The membership might get smaller or more focused on the geographic area as the route is defined and our route is agreed." (Interviewee 7)

This is also highlighted by Ruiten et al [19] when describing the 'opening up' and 'closing down' processes: "Opening up revolves around the improvement of the quality of decisions by accounting for a wider variety of norms, values, beliefs and knowledge claims, while closing down refers to the need to narrow down this variety in order to come to a limited number of commitments or conclusions, which is a crucial step towards making a decision" (p. 2).

Beyond the question of who participates, it is critical to understand who organizes public engagement processes. For renewable energy sources, projects analyzed were either developed by companies [39], municipalities [132], or public-private cooperation [138]. However, public engagement is reported to be mostly led by cities [36], [95], [131], including local governments and authorities [39], [62], [101], [139]; in some case also by project developers [63], [136], [140] or non-governmental organizations [85]. Considering the analyzed literature for electricity grid projects, TSOs led both the project and the engagement process in most cases [19], [20], [58], [61], [76], [94], [96]. One interviewee (3) mentioned that there are many different realities of who engages and when in the process. They emphasized that in an ideal world, the community would have an idea where infrastructure should be, however, most of the time the developer comes first.

As mentioned previously, the internal structure of the engaging organization can impact the level of engagement they pursue (see **Section 3.2.1 Drivers of public engagement**). The study finds that the organizers' views of the public and their concerns also impacts the different methods employed to engage the public [19], [58], [94]. Recognizing the importance of lay knowledge can allow for co-design and more participatory approaches (Interviewee 7, 10, [19]), enabling important expertise that only locals would be aware of to feed into the project (Interviewee 7, 10, 20, 21 [57], [58], [74], [96], [141]). These discoveries can feed into the EIA process, as stated by Interviewee 10:

> "[…] when you try to engage with communities about environmental indicators, often a really good source of information is going and just talking to old people. And they just go 'Oh, yeah, that fish used to be in this river or that plant, used to grow over here'. And that that information is actually scientific data because it tells you changes and conditions and so forth. But you have to go out, find them and talk to them. If you put up a web portal that says these things you

> know and walk away, then you're not likely to get that information." (Interviewee 10)

On the other hand, companies that see residents as individualistic actors tend to act from their perspective and use approaches that simply inform stakeholders of a decision and seek their acceptance without taking their concerns into account [58], [94]. This is often referred to as the Decide-Announce-Defend (DAD) model and conveys a decision-making process that ignores the value of public engagement [19], [58], [80], [94] and contributes to social conflict and delays or event cancellation of project (Interviewee 3, 7, 10, [58]). This calls for the abundance of a technocratic planning perspective.

> "We must move from a Decide-Announce-Defend approach to a Engage-Deliberate-Design (EDD) approach of public engagement, […] as DAD fails to secure sufficient agreement and support." (Interviewee 3)

The interviewees also stated the importance of independent service providers, such as facilitators, mediators, and communication experts, in facilitating participation processes (Interviewee 1, 3, 6, 7, 21; [107]). For example, in the case of a consultation process for a planned wind farm, one expert explained:

> "[…] because [communication expert] sometimes reframed questions, he raised questions, which I did not have because I'm in the field, but he was not an expert and could potentially engage with people on a different level […]". (Interviewee 7)

In addition, knowledge-brokers can play an important role in connecting different stakeholders [80]. Fast [109] described how community liaison committees in wind energy siting can bridge communication between wind energy companies and members of the public on issues related to the construction, operation and maintenance of wind energy projects, and that it could reduce conflicts and enhance engagement in wind energy development in Ontario, Canada.

In sum, there are different actors involved in energy infrastructure projects. It is important to note that communities, for example, consist of many different individuals and not only one public.

3.4.2 Common and recommend methods and formats

Not only will different people need to be involved, but they may also prefer very different forms of engagement; thus, analyzing different procedures and methods is crucial [142].The review of recent literature and the interviews revealed methods and formats follow the three levels of participation described earlier (see **Introduction**).

***'Information provision'* can be seen as a 'bottom-line' approach to engagement.** This one-way interaction happens most commonly and defines the public as passive consumers rather than energy citizens [143]. The analysis shows that written information material (such as leaflets, flyers, brochures, webpage, mailings etc.) were most likely to support the sharing of information (Interviewee 7, 11, 12, 20, [36], [39], [58], [76], [143]). Other approaches

allowed for a digital visualization of the project's impacts, such as simulations and photo-manipulation to demonstrate the effects on landscape [40], [144].

Developers and governments have heavily relied on information campaigns, which sought to 'raise awareness' and 'educate' the public (Interviewees 10, 12, 19 [145]). However, those are likely ineffective in changing minds and behaviors alone, and thus must be integrated into a wider public engagement strategy (Interviewee 16, [145]). As Coleby et al. [68] put it: "even the most comprehensive questionnaire approach to collecting opinions does not allow respondents to interact".

When providing information to the public, organizers of engagement processes should also bear in mind the approach employed within the selected methods, as they can facilitate a meaningful engagement. Good practices mentioned during the interviews include: offering materials that possess an non-technical and understandable language and are easily accessible to the public (Interviewee 10, 21); for in-person engagement, conducting engagement processes in the public's known settings and locations (Interviewee 10); maintaining transparency, and answering all concerns and questions (Interviewee 7, 10, 12, 16, 20, 21), while also taking actions to be approachable and available (Interviewees 7, 12, 20, 21). Thus, engagement as information provision alone is unlikely to be effective for creating trust and support for infrastructure projects [142]. As stated by Interviewee 21 regarding the importance of good communication and bringing the topic into the public's reality:

> "My rule of thumb is 'don't make it boring'. Like, you know, energy is kind of boring for a lot of people or it's too complicated or technical. So, I think communicating with people around what's important to them can be effective." (Interviewee 21)

Engagement as *'consultation'* can enable a dialogue between the public and energy infrastructure developers. This dialogue allows the public to ask questions and provide responses, and to discuss reasons for support/opposition. Most commonly, articles described a writing platform open to the public to provide input within a limited timeframe (Interviewees 7, 10, 11, 12, 16, 20, [36], [58], [61], [76], [78], [143]). This included gathering feedback from residents and stakeholders through websites and letters. This also allowed local groups to organize themselves to use proforma letters, which were guided by stakeholders such as NGOs and included articulated arguments, promoting an increased reach within the community [39]. Public opinion surveys among households were also very prominent, specifically at the beginning of projects [24], [101]. Other cases described community consultation through call centers or telephone lines [94]. Interviewees also highlighted the need to keep the public up to date about developments in the community (Interviewees 4, 7, 18, 20), which can be implemented by information centers or hubs in the place to have someone to address questions by the citizens (Interviewee 4). One interviewee stated:

> "But the core is that we get out physically and speak to people in person […] and that really helps build those relationships and for people to understand that we are, we are human being is all trying to

> really work to build a successful project that works with them […].” (Interviewee 20)

Some studies highlighted the need for in-person events, which served both the purposes of knowledge sharing and gathering [36], [58], [61], [62], [96], as well as creating an environment for informal discussions that fostered a lasting relationship of trust with stakeholders (Interviewees 7, 10, 12, 20; [58], [61], [96]). This echoes some of the findings from the interviews, as for example one interviewee [18] explained that they apply an extensive consultation as they have the ambition to stay and to operate the renewable energy plants. In contrast, companies may use a less intensive consultation process when they have developed the strategy to sell projects and not be the long-term owners (Interviewee 18).

Although there’s a public preference for face-to-face interaction (Interviewees 2, 4, 7, 10 and 12), digital tools also play an important role in reaching out to a wider audience (Interviewees 10, 11, 12, 16, 20, 21), including the use of innovative digital platforms to showcase the impact of the project (Interviewee 2, 4, 8). For example, Berry et al. [144] tested different visualization approaches to enhance public participation in wind farm planning and found that participants preferred photos over maps for assessing the potential landscape and visual impacts of wind farms.

***Empowerment* is the third approach to engagement. It provides the public with a co-design opportunity to be involved from the drafting of concerns to be included in the EIA to the siting of the project** (Interviewee 7, 10; [19], [62], [94], [146], [147]). This also applies to the creation of community forums or committees, which represent different stakeholder groups and allow their perspectives to be incorporated into the overall project design (Interviewee 7; [62], [76], [87], [141]. Interviewee 7 described the effort to put communities at the center of the project strategy:

> “[…] we set up those community forums, we have workshops with the local community. We demonstrate how we take the community's views on board. We bring them on a journey with us into kind of introducing co-design mechanisms. So, for instance, when we're designing a route. Before we have a route, we will ask the community what principles they would like us to follow as we design the route. So, they'll say things like: ‘Don't dig up the motorway’, ‘Do not go outside a school or a church’, and we then feed those that feedback into our route modelling to try and avoid those things before we ever have a draft route." (Interviewee 7)

Another way of creating co-design mechanisms for communities described by the analysis would be involving them in co-designing financial compensation mechanisms to the local community (Interviewee 7; [76], [84]). As the literature identified, the engaged public is interested in creating local benefits for their community rather than an individualistic approach [20], [32], [40], [76], [84], [136]. Thus, involving them in defining the criteria for a community fund or financial compensation mechanisms can create a general feeling of trust towards the project, while also avoiding the fund to be perceived as a bribe to promote acceptance (Interviewee 7; [20], [76], [84]).

The use of more deliberative participation processes is consistent within the literature reviewed in wind [31], [148], grids [5], [20], [58], [76] and biomass [103]. Langer et al. [31] suggest that the “these forms of participation should include transparent provision of information and also the possibility for citizens to state their opinions in such a way that it can be taken into account in the development and implementation of wind energy projects” (p. 69). Interviewee 25 reported on a 'Sustainable Development for Wind Energy' project in a region of Sweden, which aimed to understand what was needed to increase acceptance of wind energy. The conclusion was that it would be very beneficial to have a deeper democratic dialogue within the community on climate change and the energy transition before actual energy infrastructure developments take place.

Another approach described as an empowering method involves the representation of citizens through elections to define councilors who would lead the project [143]. Similarly, interviewees (18, 22) from Sweden and the Netherlands reported that communities have the right for a vote over new energy infrastructure projects. In the case of a wind energy project with high opposition, they plan to avoid the veto and withdraw the project to be able to come back to the community at a later stage.

Table 6 on pages 42-43 summarizes different formats and methods identified.

Table 6: Formats and methods for public engagement in energy infrastructure.

Level of participation	Method/ Format	Purpose	Country context	Technology	Examples from the literature	Literature and interview references
Information	Written information provision	Public can share their knowledge	Denmark, Germany, Ireland, Netherlands, Scotland, UK	Grids, wind energy	Leaflets, flyers, brochures, webpage, mailings, posters	Interviewee 7, 10, 12, 18, 19, 20, [36], [39], [58], [61], [76], [78], [143], [144], [148], [149]
Information	In-person events	Share information, answer questions	Denmark, Ireland, Netherlands, Sweden	Grids	Informational sessions, workshops	Interviewee 10, 11, 12, 16, 18, 19, 20, 21 [36], [57], [61]
Information	Educational & cultural activities	Gain trust, create awareness	Netherlands, Switzerland, Ireland, UK	Wind energy, solar energy & heat	School trips to renewable energy facilities, learning activities, stand in local fairs and events	Interviewee 10, 12, 16, 18, 21, [62], [96], [137], [143]
Information	City networks	Not specified	Sweden	Heating & wastewater	EU Green capitals network	[143]
Consultation	Open public consultation in written formats	Gather feedback of oppositions to the project	Denmark, Netherlands, Sweden, UK	Grids, wind energy	Proforma letters, letters sent to governmental authorities	Interviewees 7, 10, 11, 12, 16, 20, [20], [36], [39], [58], [61], [76], [78], [136], [141], [143]
Consultation	Written consultations	Opinion about technologies, or specific options for a project	China, UK, Wales and Scotland	Solar energy, wind energy, cross-tech	Household surveys	Interviewee 10, 18, [68], [140], [144], [150], [151]
Consultation	In-person events	Share information, gather feedback, create trust	Denmark, Germany, Netherlands, Ireland, Switzerland, Sweden, UK, Jordan, Malawi, South Africa, Ireland	Wind energy, grids, biogas	Public exhibitions, public hearings, workshops, roundtables, info markets, site visits	Interviewee 7, 10, 18, 19, 20, [36], [57], [58], [61], [62], [136], [147], [148], [152]
Consultation	Presenting a visualization/ simulation of the project	Share information and gather feedback	Germany, UK, USA	Wind energy, solar energy	Dedicates websites, online tools, photo manipulation, interactive web mapping, 3D models	Interviewee 20, [40], [133], [144], [149]

Consultation	Meeting points	Share information, gather feedback, exchange of knowledge	Netherlands, UK	Wind energy, solar energy	Dedicated call centers, energy service point	[94], [137]
Empowerment	Local communities' forums/ committees	Co-design / co-ownership / co-production	Belgium, Denmark, Germany, Ireland, South Africa, UK, USA	Grids, wind energy, hydrogen, solar energy, heat	One "umbrella" of several different initiative to engage the public in representative governance groups that will co-design of the project	Interviewee 7, 10; [19], [62], [78], [87], [94], [146], [147]
Empowerment	Financial compensation mechanisms	To create positive impacts, involving citizens into the creation of community funds	Ireland, USA	Grids	Community funds, which are defined by local stakeholders, and fund local businesses with social projects	Interviewee 7; [20], [76], [146]
Empowerment	Community representation	Engage the public through elections, through local (neighborhood) level	Sweden, UK	Grids, heating network, heat energy from biomass	Public officials are indirectly elected to manage municipal renewable energy sources; the UK's 2011 Localism Act	Interviewee 18, 22, [143]
Empowerment	Initiatives coming from residents	Protest, express discontent	Sweden, UK	Wind energy	Protest groups; letters sent by residents to governmental authorities, leaflets handed to other residents to inform about the protests and its motives; protest social media groups	Interviewee 18, 20

Table continued.

3.4.3 Benefits and challenges of methods and formats

Informational formats can lead to a common understanding of the project, especially when the used approach highlights a transparent process [19], [58], [131], [147]. Provision of information is also very important in translating the project's technical details into accessible language and appealing communication formats (Interviewee 21; [74]). At the same time, a wider strategy can be utilized to create awareness to the need of building energy infrastructure and developing climate actions in general, avoiding these questions to be formulated once projects are being developed and possibly reducing public opposition (Interviewees 11, 12, 16, 21).

On the other hand, **consultation methods that allow stakeholders and public to feed their feedback into the process is also a necessary step for energy projects**, included in the legal framework on international, EU and national levels [18], [36], [40], [57], [62], [74], [87], [94], [141]. According to the interviews and the reviewed literature, including the interested public's inputs into the project can lead to reduced opposition and related delays on the project timeframe, as well as help build consensus (Interviewee 7, 10, 20, 21; [19], [94]), creating trust while also allowing the public to have their concerns answered and take informed decisions (Interviewee 10, 11; [58], [84], [94], [147]).

However, once opportunities have been created for stakeholders to voice their concerns, this feedback needs to be incorporated into the project [19], [94], [141], [147]. A challenge is to translate the results from deliberative and consultation engagement processes into decision-making [5]. This would also require that the planning processes allows for alterations or modifications based on public opinions [19], [74]. Furthermore, transparency and consistent communication about whether, and how, public input has been incorporated into the final design is essential (Interviewees 7, 10 [5], [58], [69], [131], [153]). To increase acceptance, Stober et al. [154] argued that it is important to move from instrumental rationales, which see effective participation as merely a means to make decisions more legitimate, to substantive rationales, which assert that lay judgments are just as, or even more, valid than those of experts.

One further challenge relates to how public input from engagement activities may only focus on specific concerns and objectives instead of offering alternative solutions, which can create a perception among decision-makers of being constrained [74]. Thus, even for one-time projects, repeated public consultation is crucial, as actors learn over time how to make the right contribution to the process [69]. Similarly, another challenge relates to the fact that outcomes of public participation processes remain, to some extent, difficult to predict [80], and if done poorly, engagement can result even in fragmented opinions (Interviewee 10; [101]).

Top-bottom consultation approaches seem to be unsuccessful in bringing different views to the table and dealing with opposition [39], [61], leading to a limited conversation with stakeholders [94], [141]. This was supported by interviewees who noted a reduction in delays and an increase in acceptance with more participatory and innovative approaches, such as community forums (Interviewees 7, 10, 12). According to Interviewee 7, after analyzing the reason behind years of delays in different large-scale grid projects, "it became

very apparent that it was through a lack of public engagement and a lack of consultation or meaningful participation from citizens in the process." (Interviewee 7).

Therefore, consensus building, and collaborative decision-making can be achieved through *empowering* engagement. The analysis has shown that these processes generally result in the best possible solutions, which are less likely to encounter problems in the implementation phase [19], [80], [94]. Collaborative processes can also provide long-term benefits that go beyond specific cases, such as developing trust within the community and allowing an inclusive approach (Interviewees 7, 10, 20, 21; [29], [58], [85], [94], [105], [141]). As Jami and Walsh [80] emphasized, knowledge exchange can lead to community building, reflections on inclusive ways of decision-making that reflects the wisdom, experience and voice of local residents, and eventually enhance trust among stakeholders when they see how their input might be valued instead of being rejected or ignored. Thus, deliberative and collaborative processes with increased dialogue and early engagement can be seen as a precautionary approach to prevent protests [131].

However, co-creation can also have shortcomings, including constrains around political support and resources availability, complicating their implementation [105]. Public engagement processes in general take time and require financial resources to facilitate meaningful dialogues. Thus, an additional challenge is increasing internal support for collaborative engagement processes within the organizations being responsible for the engagement and public participation [19], [94]. Lack of staff and limited time can be key challenges to meaningful engagement, especially in the case of co-creation processes (Interviewee 7; [19], [58], [94], [105]).

There are also different prospects and challenges underlying the use of in-person *versus* online engagement [155]. Digital and online approaches provide an opportunity for the public to better comprehend the project's final stage and feed into consultation processes using dedicated online consultation portals (Interviewee 7), as well as simulation and photo manipulation techniques [40], [144], [149]. On the other hand, online workshops and events might allow new target groups (i.e. citizens with reduced time availability, such as families) to be engaged (Interviewees 11, 21). However, challenges related to attendance and participation must be considered when moving to an online approach, as vulnerable groups might not have access to internet connection, and the public might not actually express their thoughts as much as during an in-person setting (Interviewees 7, 10, 12). On the other hand, in-person events that provide an environment for participants to engage with the organizers of engagement processes informally are reported to create trust and lasting relationships (Interviewees 7, 10, 12, 21, [58], [94], [131], [141]). Thus, a hybrid mix of these methods was described as the best solution possible (Interviews 7, 10, 12, 20, 21; [148]).

It is important to note that the use of specific methods alone does not guarantee meaningful public engagement or acceptance to energy infrastructure projects. On this note, some challenges must also be considered, including the need for early engagement, transparency, inclusiveness, accessibility, and consistent communication to achieve meaningful engagement [19], [58], [74], [76], [85], [87], [147]. The results of the methods used will also vary depending on whether engagement is seen as a necessary and important step in the project to gather knowledge and feedback from lay people, or whether organizations aim their activities to increase acceptance regardless of the public's feedback [19], [39]. The latter approach can be viewed as condescending or arrogant by the public,

leading to opposition, or false acceptance that, in reality, entails lack of power [18]–[20], [76], [94].

Apart from that, other challenges might be out of the control of the engagement organizers to prevent them. According to Interviewee 20, even while promoting a collaborative engagement with the communities for years, a recent project has been suffering with disinformation from an opposition group. With distribution of false information and inciting citizens to avoid any type of contact with the developer, the efforts to create a collaborative outcome have faced challenges:

> "As a country, we need to secure our energy and we need to connect these renewables for net zero. So, they're never going to put a stop to it. But because they're having such an influence on people to just don't engage with us and just say no… It's actually stopping us getting really good local information or it's stopping them from actually having more informed conversations with us where we can actually maybe put some of their fears to rest" (Interviewee 20)

In conclusion, a mix of different methods and formats is necessary for a fair and meaningful engagement. To mitigate limitations of single methods, Corscadden et al. [30] recommend "the use of multiple information sessions in conjunction with consultation, the use of public meetings for expression of ideas and dissemination of information as well as the use of online forums for receiving feedback from the community" (p. 397). Bidwell [38] called for more experimentation in participation and to document, evaluate and compare the various approaches to public engagement across cases.

4 Implications and conclusions: How can barriers be overcome, and drivers of public engagement encouraged?

This report shows that public engagement with energy infrastructure can be driven or hindered by different factors. The public is motivated to participate because they are affected by and concerned about projects and want to use their decision-making power to influence the design of projects. They are also motivated by broader environmental concerns and financial incentives. Drivers for project promoters and developers to involve the public are: mitigating local opposition that delays or stops projects as well as legal requirements to carry out the engagement and participation processes. The main barriers to public participation are a lack of timely, transparent, consistent, and reliable information about the project, its needs and benefits, and a lack of trust in developers or local authorities. For developers, barriers include a lack of awareness of the importance of public engagement processes and a lack of skills in designing meaningful public engagement processes. Although more and more governments have legal requirements and guidelines for public engagement, the extent to which they are followed can vary from department to department. Too often, legal and financial barriers prevent meaningful public engagement, especially when it comes to opportunities for community (co-)ownership of energy infrastructure.

This study also demonstrates the complexity of meaningful public engagement. Poorly designed participation processes can lead to anger and mistrust, which can be an obstacle to acceptance [156], or lead to project failure [102], [103]. In fact, how participation processes are organized and by whom determines the outcomes of participation [24]. Thus, high quality and meaningful public engagement is crucial [31] to add value to the energy infrastructure projects for both the public and developers. This requires participation spaces and more democratic ways of working between policy makers, the private sector and local communities.

This report, furthermore, shows that there are different forms of public engagement with energy infrastructure. All forms, from information to consultation and empowerment, are valid and contribute to a higher acceptance of energy infrastructure projects. Different methods and formats have their advantages and limitations, but in general, there is a need for continuous engagement throughout the project development [30], giving the public the opportunity to influence the project development [74] and implementing different engagement activities can increase the fairness and inclusiveness of public participation in energy infrastructure projects. Transparency of the public engagement process and its impact on the overall project design is considered critical [5], [58], [69], [131].

The research also shows that public engagement is about more than building public acceptance. Meaningful public engagement in energy infrastructure projects can have multiple benefits: It allows the public to voice concerns about infrastructure development and offer opinions about technologies and siting [138], can lead to an improved decision quality and legitimacy [85], increases transparency in decision-making [85], leads to better-informed decisions that meet public needs [85], [140], it reduces delays in permitting and construction

times, reduces opposition to energy infrastructure [5], [19], [20], [103], and builds trust between project developers and the community [19], [96]. Although public participation cannot be seen as silver bullet for achieving acceptance [38], it is more likely that a greater involvement of interested stakeholders in a participatory way will lead to such an outcome.

The study also demonstrates the importance of the local context in which a specific energy project is to be implemented. Wesche et al. [18] wrote that "the main challenge seems to be the application of the available knowledge to the conditions of a specific project". This point underscores the need to understand local conditions, societal values and public concerns and needs. Any energy infrastructure project implies changes to communities and landscapes, which requires public engagement to enable fair, inclusive and equitable (transition) processes.

Based on an extensive literature review and expert interviews, some key implications can be drawn on how to overcome barriers of or challenges to public engagement in energy infrastructure:

- **Challenge: Varying purposes and understandings of public engagement**

  Public engagement processes should have a clearly defined purpose, which will also ensure the evaluation of processes. The purpose will also define formats and methods applied to engage the public.

- **Challenge: Public inclusion in the decision-making process**

  Public engagement should clearly define the representation of 'the public'. A clear understanding of *who* should be involved ensures that citizens and communities affected by the infrastructure project are involved. Inclusion of different stakeholders is essential to obtain diverse and multiple views. Inclusiveness is not only important in terms of participants, but also in terms of equal consideration of different voices in the process.

- **Challenge: Public trust towards developers and local authorities**

  Public engagement processes need to be transparent and fair to create an atmosphere of trust and transparency. This requires that affected citizens and communities on the ground and project promoters or developers from outside are better connected and meet in engagement spaces.

- **Challenge: Timing of engagement**

  The public should be engaged even before the start of the project and throughout the life cycle of an energy infrastructure project, from planning to decommissioning. This requires good procedures for ongoing engagement.

- **Challenge: Representation of concerns and needs in energy infrastructure projects**

  Public engagement processes should start with an understanding of the local context and the public's perspectives. Listening to citizens enables them to express what issues/aspects are important to them and why. In addition, the public should be asked *how* they want to be involved in energy infrastructure development, as not all citizens want to be involved in the same way.

- **Challenge: Sufficient and timely communication and information provision**

Public engagement needs to ensure that affected citizens are clearly told *why* a particular project is needed and why it makes sense in a particular area/location. Benefits and drawbacks must also be clearly communicated to ensure that people understand both opportunities and negative impacts. Information must be tailored to the needs of the audience. The public should be able to find information about proposed infrastructure projects and no information should be “hidden behind their backs”.

- **Challenge: Impact of consultation on decision making**

Public participation processes need to ensure that the mandate of the participants in a process is clearly communicated and that the impact of the results of the process on decision-making is specified. Public participation can be (perceived to be) purely symbolic, as decisions are predetermined, or the influence on decisions is too limited. Best practice is for the public to have the opportunity to influence decision-making. This requires consultation between the public and decision-makers.

- **Challenge: Choice of formats and methods**

Different formats and methods can include and/or exclude certain people. While it might not be possible to include the unwilling, combining different formats and methods can ensure that the ones who want to participate will be able to do so. It is important to consider that different phases of infrastructure developments offer differ opportunities for engagement.

- **Challenge: Understanding the value of public participation**

Public engagement must be desired by policy makers and practitioners. Engagement often remains at the level of 'information' and 'consultation' and does not reach 'empowerment' where the public would be given authority over the outcome of the project. A challenge highlighted in literature is existing power relations where the public is not given the space to influence decisions.

- **Challenge: Skills for meaningful public engagement**

Public engagement processes should use different formats and tools to facilitate engagement, as different audiences need to be engaged in different ways in different points in time. Effective design of such processes requires awareness raising and capacity building, including sharing of good practices, among those implementing energy infrastructure. Neutral facilitators, mediators or communication experts can play an important role in "translating" the perspectives of both sides.

- **Challenge: Frameworks and principles to guide participation**

Public participation processes should be based on public participation guidelines or legal frameworks that ensure that people who want to be involved can participate in energy infrastructure projects and the additional measures undertaken by projects developer will be acknowledged by the regulators.

4.1 Outlook for future research

Recent research shows a strong focus on public engagement in wind energy and electricity grid infrastructure. While awareness of participation is growing here, the question remains whether public engagement in other energy technologies, such as solar energy, storage, and hydrogen, will receive more attention in the future. Future research is needed that addresses public participation in large-scale infrastructure beyond wind energy and grids, including emerging technologies that are currently being piloted.

In addition, this study shows that participation can take many forms and identifying best practices requires a better understanding of the advantages and disadvantages of different participation models [38] in different contexts and governance structures. Most studies have been conducted in Europe and North America, so research in different settings is needed to understand what can be transferred or where different approaches to public engagement are needed.

4.2 Policy recommendations

Based on the key findings, we make three main policy recommendations:

1. Policymakers need to better communicate and raise awareness about the opportunities for public engagement with energy infrastructure projects. This engagement should highlight that infrastructure projects are key to enabling the energy transition, and can bring benefits to the public. Any engagement strategy should also aim to integrate national climate and energy action plans into the local context of citizens.
2. Greater awareness and capacity building is needed for businesses, including planners and developers, on the importance of public engagement for a rapid and just energy transition, including best practices for public engagement.
3. There is a need for closer cooperation between different actors to enable knowledge sharing and collaboration on public engagement with energy infrastructure projects. Policy makers should initiate a "community of practice" to enable different actors to share experiences and initiate mutual learning within and across energy technologies, and to ensure that participation and engagement processes on the ground are inclusive.

Bibliography

[1] IEA, “Net Zero by 2050,” Paris, https://www.iea.org/reports/net-zero-by-2050, License: CC BY 4.0, 2021.

[2] IEA, “Tracking Clean Energy Progress 2023, , IEA, Paris, https://www.iea.org/reports/tracking-clean-energy-progress-2023, License: CC BY 4.0,” 2023.

[3] IEA, “World Energy Investment 2022,” 2022. [Online]. Available: www.iea.org/t&c/

[4] Lutz Ribbe and Thomas Kattnig, “Opinion of the European Economic and Social Committee on ‘Between a trans-European super grid and local energy islands-the right mix of decentralised solutions and centralised structures for an economically, socially and ecologically sustainable energy transition’ (own-initiative opinion),” *Official Journal of the European Union*. Dec. 10, 2020.

[5] K. Rottman, “Recommendations on Transparency and Public Participation in the Context of Electricity Transmission Lines,” 2013.

[6] T. Tröndle, J. Lilliestam, S. Marelli, and S. Pfenninger, “Trade-Offs between Geographic Scale, Cost, and Infrastructure Requirements for Fully Renewable Electricity in Europe,” *Joule*, vol. 4, no. 9, pp. 1929–1948, Sep. 2020, doi: 10.1016/j.joule.2020.07.018.

[7] European Commission, “REPowerEU: Joint European Action for more affordable, secure and sustainable energy.” Strasbourg, Mar. 08, 2022.

[8] C. A. Miller, J. Richter, and J. O’Leary, “Socio-energy systems design: A policy framework for energy transitions,” *Energy Res Soc Sci*, vol. 6, pp. 29–40, Mar. 2015, doi: 10.1016/j.erss.2014.11.004.

[9] European Commission, “Standard Eurobarometer 99 - Spring 2023,” Jul. 2023.

[10] B. K. Sovacool *et al.*, “Conflicted transitions: Exploring the actors, tactics, and outcomes of social opposition against energy infrastructure,” *Global Environmental Change*, vol. 73, p. 102473, Mar. 2022, doi: 10.1016/j.gloenvcha.2022.102473.

[11] P. Devine-Wright, “Rethinking NIMBYism: The role of place attachment and place identity in explaining place-protective action,” *J Community Appl Soc Psychol*, vol. 19, no. 6, pp. 426–441, Nov. 2009, doi: 10.1002/casp.1004.

[12] D. Süsser, M. Döring, and B. M. W. Ratter, “Harvesting energy: Place and local entrepreneurship in community-based renewable energy transition,” *Energy Policy*, vol. 101, 2017, doi: 10.1016/j.enpol.2016.10.018.

[13] K. Borch, “Mapping value perspectives on wind power projects: The case of the danish test centre for large wind turbines,” *Energy Policy*, vol. 123, pp. 251–258, Dec. 2018, doi: 10.1016/j.enpol.2018.08.056.

[14] C. C. Voigt, T. M. Straka, and M. Fritze, “Producing wind energy at the cost of biodiversity: A stakeholder view on a green-green dilemma,” *Journal of Renewable and Sustainable Energy*, vol. 11, no. 6, Nov. 2019, doi: 10.1063/1.5118784.

[15] V. Kati, C. Kassara, Z. Vrontisi, and A. Moustakas, “The biodiversity-wind energy-land use nexus in a global biodiversity hotspot,” *Science of The Total Environment*, vol. 768, p. 144471, May 2021, doi: 10.1016/j.scitotenv.2020.144471.

[16] M. K. McBeth, M. Warnement Wrobel, and I. van Woerden, “Political ideology and nuclear energy: Perception, proximity, and trust,” *Review of Policy Research*, vol. 40, no. 1, pp. 88–118, Jan. 2023, doi: 10.1111/ropr.12489.

[17] Z. Clulow, M. Ferguson, P. Ashworth, and D. Reiner, “Comparing public attitudes towards energy technologies in Australia and the UK: The role of political ideology,” *Global Environmental Change*, vol. 70, p. 102327, Sep. 2021, doi: 10.1016/j.gloenvcha.2021.102327.

[18] Wesche J.P., Dütschke E., and Schneider U., “People vs. Windfarms? - To what extent are strategies for public participation used to foster social acceptance in the European wind energy sector?,” EWEA Annual Event 2015, 2015.

[19] K. Ruiten *et al.*, “Drawing the line: Opening up and closing down the siting of a high voltage transmission route in the Netherlands,” *Land use policy*, vol. 132, p. 106804, Sep. 2023, doi: 10.1016/j.landusepol.2023.106804.

[20] M. Koelman, T. Hartmann, and T. J. M. Spit, “It’s not all about the money—landowner motivation and high voltage grid development,” *Journal of Environmental Policy & Planning*, vol. 25, no. 3, pp. 211–224, May 2023, doi: 10.1080/1523908X.2022.2093175.

[21] Y. Zhou, L. Hou, Y. Yang, H.-Y. Chong, and S. Moon, “A comparative review and framework development on public participation for decision-making in Chinese public projects,” *Environ Impact Assess Rev*, vol. 75, pp. 79–87, Mar. 2019, doi: 10.1016/j.eiar.2018.12.006.

[22] Ø. Aas, P. Devine-Wright, T. Tangeland, S. Batel, and A. Ruud, “Public beliefs about high-voltage powerlines in Norway, Sweden and the United Kingdom: A comparative survey,” *Energy Res Soc Sci*, vol. 2, pp. 30–37, Jun. 2014, doi: 10.1016/J.ERSS.2014.04.012.

[23] M. Wolsink, “Wind power and the NIMBY-myth: institutional capacity and the limited signicance of public support,” *Renew Energy*, vol. 21, pp. 49–64, 2000, [Online]. Available: www.elsevier.com/locate/renene

[24] J. Chilvers, R. Bellamy, H. Pallett, and T. Hargreaves, “A systemic approach to mapping participation with low-carbon energy transitions,” *Nat Energy*, vol. 6, no. 3, pp. 250–259, Mar. 2021, doi: 10.1038/s41560-020-00762-w.

[25] P. Devine-Wright, *Renewable Energy and the Public From NIMBY to Participation*, 1st ed. Routledge, 2011.

[26] P. J. Schweizer *et al.*, “Public participation for infrastructure planning in the context of the German ‘Energiewende,’” *Util Policy*, vol. 43, pp. 206–209, Dec. 2016, doi: 10.1016/j.jup.2014.07.005.

[27] B. Oppermann and O. Renn, “Partizipation und Kommunikation in der Energiewende,” *Schriftenreihe Energiesysteme der Zukunft (ESYS). Source: https://www.acatech.de/publikation/partizipation-und-kommunikation-in-der-energiewende/.*, 2019.

[28] P. Devine-Wright, “Local aspects of UK renewable energy development: exploring public beliefs and policy implications,” *Local Environ*, vol. 10, no. 1, pp. 57–69, Feb. 2005, doi: 10.1080/1354983042000309315.

[29] A. Jami and P. Walsh, “Wind Power Deployment: The Role of Public Participation in the Decision-Making Process in Ontario, Canada,” *Sustainability*, vol. 8, no. 8, p. 713, Jul. 2016, doi: 10.3390/su8080713.

[30] K. Corscadden, A. Wile, and E. Yiridoe, “Social license and consultation criteria for community wind projects,” *Renew Energy*, vol. 44, pp. 392–397, Aug. 2012, doi: 10.1016/j.renene.2012.02.009.

[31] K. Langer, T. Decker, and K. Menrad, “Public participation in wind energy projects located in Germany: Which form of participation is the key to acceptance?,” *Renew Energy*, vol. 112, pp. 63–73, 2017, doi: 10.1016/j.renene.2017.05.021.
[32] I. Suboticki, S. Heidenreich, M. Ryghaug, and T. M. Skjølsvold, “Fostering justice through engagement: A literature review of public engagement in energy transitions,” *Energy Res Soc Sci*, vol. 99, p. 103053, May 2023, doi: 10.1016/j.erss.2023.103053.
[33] European Commission, “Communication and roadmap on the European Green Deal. COM (2019) 640 final.” 2019.
[34] G. Rowe and L. J. Frewer, “A Typology of Public Engagement Mechanisms,” *Sci Technol Human Values*, vol. 30, no. 2, pp. 251–290, Apr. 2005, doi: 10.1177/0162243904271724.
[35] H. Catt and M. Murphy, “What voice for the people? categorising methods of public consultation,” *Aust J Polit Sci*, vol. 38, no. 3, pp. 407–421, Nov. 2003, doi: 10.1080/1036114032000133967.
[36] L. T. Clausen, D. Rudolph, and S. Nyborg, “The good process or the great illusion? A spatial perspective on public participation in Danish municipal wind turbine planning,” *Journal of Environmental Policy & Planning*, vol. 23, no. 6, pp. 732–751, Nov. 2021, doi: 10.1080/1523908X.2021.1910017.
[37] J. Gaventa, “Finding the Spaces for Change: A Power Analysis,” *IDS Bull*, vol. 37, no. 6, pp. 23–33, Nov. 2006, doi: 10.1111/j.1759-5436.2006.tb00320.x.
[38] D. Bidwell, “Thinking through participation in renewable energy decisions,” *Nature Energy*, vol. 1. Nature Publishing Group, Mar. 04, 2016. doi: 10.1038/nenergy.2016.51.
[39] M. Aitken, C. Haggett, and D. Rudolph, “Practices and rationales of community engagement with wind farms: awareness raising, consultation, empowerment,” *Planning Theory & Practice*, vol. 17, no. 4, pp. 557–576, Oct. 2016, doi: 10.1080/14649357.2016.1218919.
[40] N. M. Mostegl, U. Pröbstl-Haider, and W. Haider, “Spatial energy planning in Germany: Between high ambitions and communal hesitations,” *Landsc Urban Plan*, vol. 167, pp. 451–462, Nov. 2017, doi: 10.1016/j.landurbplan.2017.07.013.
[41] P. Emmerich, A.-G. Hülemeier, D. Jendryczko, M. J. Baumann, M. Weil, and D. Baur, “Public acceptance of emerging energy technologies in context of the German energy transition,” *Energy Policy*, vol. 142, p. 111516, Jul. 2020, doi: 10.1016/j.enpol.2020.111516.
[42] F. Ribeiro, P. Ferreira, M. Araújo, and A. C. Braga, “Public opinion on renewable energy technologies in Portugal,” *Energy*, vol. 69, pp. 39–50, May 2014, doi: 10.1016/j.energy.2013.10.074.
[43] IEA, “Renewables 2022. Renewables 2022, IEA, Paris https://www.iea.org/reports/renewables-2022, License: CC BY 4.0,” 2022.
[44] IPCC, “Summary for Policymakers. Synthesis Report of the IPCC Sixth Assessment Report. https://report.ipcc.ch/ar6syr/pdf/IPCC_AR6_SYR_SPM.pdf,” 2023.
[45] IEA, “Electricity security in tomorrow’s power systems,” Webpage: https://www.iea.org/articles/electricity-security-in-tomorrow-s-power-systems.
[46] IRENA - International Renewable Energy Agency, “World Energy Transitions Outlook: 1.5°C Pathway,” 2023. Accessed: Jul. 25, 2023. [Online]. Available: https://irena.org/Digital-Report/World-Energy-Transitions-Outlook-2022%0Ahttps://irena.org/publications/2021/March/World-Energy-Transitions-Outlook

[47] P. Devine-Wright, “From Backyards to Places: Public Engagement and the Emplacement of Renewable Energy Technologies,” in *Renewable Energy and the Public. From NIMBY to Participation.*, vol. 1st Edition, D. Devine-Wright, Ed., earthscan from Routledge, 2011, pp. 57–70.
[48] S. Timmermans and I. Tavory, “Theory Construction in Qualitative Research,” *Sociol Theory*, vol. 30, no. 3, pp. 167–186, Sep. 2012, doi: 10.1177/0735275112457914.
[49] P. Devine-Wright and F. Sherry-Brennan, “Where do you draw the line? Legitimacy and fairness in constructing community benefit fund boundaries for energy infrastructure projects,” *Energy Res Soc Sci*, vol. 54, pp. 166–175, Aug. 2019, doi: 10.1016/j.erss.2019.04.002.
[50] European Commission, “Communication and roadmap on the European Green Deal. COM (2019) 640 final.” 2019.
[51] S. R. Arnstein, “A Ladder Of Citizen Participation,” *J Am Inst Plann*, vol. 35, no. 4, pp. 216–224, Jul. 1969, doi: 10.1080/01944366908977225.
[52] M. S. Reed *et al.*, “A theory of participation: what makes stakeholder and public engagement in environmental management work?,” *Restoration Ecology*, vol. 26. Blackwell Publishing Inc., pp. S7–S17, Apr. 01, 2018. doi: 10.1111/rec.12541.
[53] B. Batidzirai *et al.*, “Towards people-private-public partnerships: An integrated community engagement model for capturing energy access needs,” *Energy Res Soc Sci*, vol. 74, Apr. 2021, doi: 10.1016/j.erss.2021.101975.
[54] L. G. Elkjær and M. Horst, “Rights or resources? Local actor roles in ‘participation’ and ‘co-creation’ in wind energy transitions,” *Energy Res Soc Sci*, vol. 97, p. 102966, Mar. 2023, doi: 10.1016/j.erss.2023.102966.
[55] P. Pandey and A. Sharma, “Knowledge politics, vulnerability and recognition-based justice: Public participation in renewable energy transitions in India,” *Energy Res Soc Sci*, vol. 71, Jan. 2021, doi: 10.1016/j.erss.2020.101824.
[56] P. Devine-Wright, “Public engagement with large-scale renewable energy technologies: Breaking the cycle of NIMBYism,” *Wiley Interdiscip Rev Clim Change*, vol. 2, no. 1, pp. 19–26, 2011, doi: 10.1002/wcc.89.
[57] C. Armeni and H. T. Anker, “Public participation and appeal rights in decision-making on wind energy infrastructure: a comparative analysis of the Danish and English legal framework,” *Journal of Environmental Planning and Management*, vol. 63, no. 5, pp. 842–861, Apr. 2020, doi: 10.1080/09640568.2019.1614436.
[58] N. Komendantova and A. Battaglini, “Beyond Decide-Announce-Defend (DAD) and Not-in-My-Backyard (NIMBY) models? Addressing the social and public acceptance of electric transmission lines in Germany,” *Energy Res Soc Sci*, vol. 22, pp. 224–231, Dec. 2016, doi: 10.1016/j.erss.2016.10.001.
[59] R. J. Citation Heffron and P. Haynes, “Challenges to the Aarhus Convention: Public Participation in the Energy Planning Process in the United Kingdom,” 2014. [Online]. Available: www.jcer.net
[60] M. Aitken, “Wind power and community benefits: Challenges and opportunities,” *Energy Policy*, vol. 38, no. 10, pp. 6066–6075, 2010, doi: 10.1016/j.enpol.2010.05.062.
[61] J. T. Porsius, L. Claassen, P. E. Weijland, and D. R. M. Timmermans, “‘They give you lots of information, but ignore what it’s really about’: residents’ experiences with the planned introduction of a new high-voltage power line,” *Journal of Environmental*

Planning and Management, vol. 59, no. 8, pp. 1495–1512, Aug. 2016, doi: 10.1080/09640568.2015.1080672.

[62] C. Ntui and I. Rampedi, “HEARTED EFFORTS BY THE MOGOGELO COMMUNITY TO PROTECT TRADITIONAL SITES BY MEANS OF PUBLIC PARTICIPATION FORUMS: A REVIEW REPORT,” *International Journal of African Renaissance Studies - Multi-, Inter- and Transdisciplinarity*, vol. 10, no. 1, pp. 153–169, Jan. 2015, doi: 10.1080/18186874.2015.1050221.

[63] M. Aitken, “A three-dimensional view of public participation in Scottish land-use planning: Empowerment or social control?,” *Planning Theory*, vol. 9, no. 3, pp. 248–264, Aug. 2010, doi: 10.1177/1473095210366193.

[64] M. Peters, S. Fudge, and S. M. Hoffman, “The persistent challenge of encouraging public participation in the low-carbon transition,” *Carbon Management*, vol. 4, no. 4. pp. 373–375, Aug. 2013. doi: 10.4155/cmt.13.32.

[65] D. Parra *et al.*, “An interdisciplinary review of energy storage for communities: Challenges and perspectives,” *Renewable and Sustainable Energy Reviews*, vol. 79. Elsevier Ltd, pp. 730–749, 2017. doi: 10.1016/j.rser.2017.05.003.

[66] M. R. Di Nucci, M. Krug, L. Schwarz, V. Gatta, and E. Laes, “Learning from Other Community Renewable Energy Projects: Transnational Transfer of Multi-Functional Energy Gardens from the Netherlands to Germany,” *Energies (Basel)*, vol. 16, no. 7, p. 3270, Apr. 2023, doi: 10.3390/en16073270.

[67] P.-J. Schweizer and J. Bovet, “The potential of public participation to facilitate infrastructure decision-making: Lessons from the German and European legal planning system for electricity grid expansion,” *Util Policy*, vol. 42, pp. 64–73, Oct. 2016, doi: 10.1016/j.jup.2016.06.008.

[68] A. M. COLEBY, D. R. MILLER, and P. A. ASPINALL, “PUBLIC ATTITUDES AND PARTICIPATION IN WIND TURBINE DEVELOPMENT,” *Journal of Environmental Assessment Policy and Management*, vol. 11, no. 01, pp. 69–95, Mar. 2009, doi: 10.1142/S1464333209003221.

[69] S. Fink and E. Ruffing, “Learning in iterated consultation procedures – The example of the German electricity grid demand planning,” *Util Policy*, vol. 65, Aug. 2020, doi: 10.1016/j.jup.2020.101065.

[70] Ø. Aas, P. Devine-Wright, T. Tangeland, S. Batel, and A. Ruud, “Public beliefs about high-voltage powerlines in Norway, Sweden and the United Kingdom: A comparative survey,” *Energy Res Soc Sci*, vol. 2, pp. 30–37, Jun. 2014, doi: 10.1016/j.erss.2014.04.012.

[71] A. Ernst and D. Fuchs, “Power dynamics, shifting roles, and learning: Exploring key actors in participation processes in the German energy transformation (Energiewende),” *Energy Res Soc Sci*, vol. 85, Mar. 2022, doi: 10.1016/j.erss.2021.102420.

[72] J. Knauf and J. le Maitre, “A matter of acceptability? Understanding citizen investment schemes in the context of onshore wind farm development,” *Renewable and Sustainable Energy Reviews*, vol. 175, p. 113158, Apr. 2023, doi: 10.1016/j.rser.2023.113158.

[73] R. Schroeter, O. Scheel, O. Renn, and P. J. Schweizer, “Testing the value of public participation in Germany: Theory, operationalization and a case study on the evaluation

of participation," *Energy Res Soc Sci*, vol. 13, pp. 116–125, Mar. 2016, doi: 10.1016/j.erss.2015.12.013.
[74] M. Lee *et al.*, "Public participation and climate change infrastructure," *Journal of Environmental Law*, vol. 25, no. 1, pp. 33–62, Mar. 2013, doi: 10.1093/jel/eqs027.
[75] M. Saldivia Olave and S. Vargas-Payera, "Environmental impact assessment and public participation of geothermal energy projects: the cases of Chile, Costa Rica, Colombia, and Mexico," in *The Regulation and Policy of Latin American Energy Transitions*, Elsevier, 2020, pp. 209–221. doi: 10.1016/B978-0-12-819521-5.00012-7.
[76] P. Devine-Wright and F. Sherry-Brennan, "Where do you draw the line? Legitimacy and fairness in constructing community benefit fund boundaries for energy infrastructure projects," *Energy Res Soc Sci*, vol. 54, pp. 166–175, Aug. 2019, doi: 10.1016/j.erss.2019.04.002.
[77] K. Corscadden, A. Wile, and E. Yiridoe, "Social license and consultation criteria for community wind projects," *Renew Energy*, vol. 44, pp. 392–397, Aug. 2012, doi: 10.1016/j.renene.2012.02.009.
[78] M. Westrom, "Winds of change: Legitimacy, withdrawal, and interdependency from a decentralized wind-to-hydrogen regime in Orkney, Scotland," *Energy Res Soc Sci*, vol. 60, Feb. 2020, doi: 10.1016/j.erss.2019.101332.
[79] A. S. Maqbool, E. van der Waal, and H. van der Windt, "'Luctor et emergo', how a community energy initiative survived the changing policy and technology landscape of the Dutch energy system?," *Energy Policy*, vol. 177, p. 113528, Jun. 2023, doi: 10.1016/j.enpol.2023.113528.
[80] A. Jami and P. Walsh, "Wind Power Deployment: The Role of Public Participation in the Decision-Making Process in Ontario, Canada," *Sustainability*, vol. 8, no. 8, p. 713, Jul. 2016, doi: 10.3390/su8080713.
[81] H. Lelieveldt and W. Schram, "Where are the citizens? Unravelling the lopsided nature of stakeholder participation in the Dutch regional energy transition," *Energy Res Soc Sci*, vol. 96, Feb. 2023, doi: 10.1016/j.erss.2022.102925.
[82] K. Ruiten *et al.*, "Drawing the line: Opening up and closing down the siting of a high voltage transmission route in the Netherlands," *Land use policy*, vol. 132, p. 106804, Sep. 2023, doi: 10.1016/j.landusepol.2023.106804.
[83] M. Cotton and P. Devine-Wright, "Discourses of energy infrastructure development: A Q-method study of electricity transmission line siting in the UK," *Environ Plan A*, vol. 43, no. 4, pp. 942–960, 2011, doi: 10.1068/a43401.
[84] P. Lienert, B. Sütterlin, and M. Siegrist, "Public acceptance of high-voltage power lines: The influence of information provision on undergrounding," *Energy Policy*, vol. 112, pp. 305–315, Jan. 2018, doi: 10.1016/j.enpol.2017.10.025.
[85] J. Schneider, P. Mudra, and A. Kozumplíková, "Public participation in the process of EIA intentions of wind power plants in the Czech Republic," *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, vol. 66, no. 1, pp. 171–182, 2018, doi: 10.11118/actaun201866010171.
[86] G. Walker *et al.*, "Symmetries, Expectations, Dynamics and Contexts: A Framework for Understanding Public Engagement with Renewable Energy Projects," in *Renewable Energy and the Public. From NIMBY to Participation*, 1st Edition., vol. 1st Edition, P. Devine-Wright, Ed., earthscan by Routledge, 2011, pp. 1–14.

[87] S. Fast, “Assessing public participation tools during wind energy siting,” *J Environ Stud Sci*, vol. 7, no. 3, pp. 386–393, Sep. 2017, doi: 10.1007/s13412-016-0419-0.
[88] C. Ntui and I. Rampedi, “HEARTED EFFORTS BY THE MOGOGELO COMMUNITY TO PROTECT TRADITIONAL SITES BY MEANS OF PUBLIC PARTICIPATION FORUMS: A REVIEW REPORT,” *International Journal of African Renaissance Studies - Multi-, Inter- and Transdisciplinarity*, vol. 10, no. 1, pp. 153–169, Jan. 2015, doi: 10.1080/18186874.2015.1050221.
[89] M. Saldivia Olave and S. Vargas-Payera, “Environmental impact assessment and public participation of geothermal energy projects: the cases of Chile, Costa Rica, Colombia, and Mexico,” in *The Regulation and Policy of Latin American Energy Transitions*, Elsevier, 2020, pp. 209–221. doi: 10.1016/B978-0-12-819521-5.00012-7.
[90] P. J. Schweizer *et al.*, “Public participation for infrastructure planning in the context of the German ‘Energiewende,’” *Util Policy*, vol. 43, pp. 206–209, Dec. 2016, doi: 10.1016/j.jup.2014.07.005.
[91] L. G. Elkjær and M. Horst, “Rights or resources? Local actor roles in ‘participation’ and ‘co-creation’ in wind energy transitions,” *Energy Res Soc Sci*, vol. 97, p. 102966, Mar. 2023, doi: 10.1016/j.erss.2023.102966.
[92] T. A. P. Metze, J. van den Broek, R. van Est, and E. H. W. J. Cuppen, “Participatory repertoires for aligning policy and society: An analysis of Dutch stakeholder views on deep geothermal energy,” *Energy Res Soc Sci*, vol. 98, p. 103019, Apr. 2023, doi: 10.1016/j.erss.2023.103019.
[93] A. Vallejos-Romero *et al.*, “Green Hydrogen and Social Sciences: Issues, Problems, and Future Challenges,” *Sustainability (Switzerland)*, vol. 15, no. 1. MDPI, Jan. 01, 2023. doi: 10.3390/su15010303.
[94] M. Cotton and P. Devine-Wright, “Discourses of energy infrastructure development: A Q-method study of electricity transmission line siting in the UK,” *Environ Plan A*, vol. 43, no. 4, pp. 942–960, 2011, doi: 10.1068/a43401.
[95] C. Armeni and H. T. Anker, “Public participation and appeal rights in decision-making on wind energy infrastructure: a comparative analysis of the Danish and English legal framework,” *Journal of Environmental Planning and Management*, vol. 63, no. 5, pp. 842–861, Apr. 2020, doi: 10.1080/09640568.2019.1614436.
[96] A. Ceglarz, A. Beneking, S. Ellenbeck, and A. Battaglini, “Understanding the role of trust in power line development projects: Evidence from two case studies in Norway,” *Energy Policy*, vol. 110, pp. 570–580, Nov. 2017, doi: 10.1016/j.enpol.2017.08.051.
[97] P. Pandey and A. Sharma, “Knowledge politics, vulnerability and recognition-based justice: Public participation in renewable energy transitions in India,” *Energy Res Soc Sci*, vol. 71, Jan. 2021, doi: 10.1016/j.erss.2020.101824.
[98] A. Ernst and D. Fuchs, “Power dynamics, shifting roles, and learning: Exploring key actors in participation processes in the German energy transformation (Energiewende),” *Energy Res Soc Sci*, vol. 85, Mar. 2022, doi: 10.1016/j.erss.2021.102420.
[99] O. Renn, F. Ulmer, and A. Deckert, Eds., *The Role of Public Participation in Energy Transitions*. Elsevier, 2020, 2020.
[100] R. Xavier, N. Komendantova, V. Jarbandhan, and D. Nel, “Participatory governance in the transformation of the South African energy sector: Critical success factors for

environmental leadership," *J Clean Prod*, vol. 154, pp. 621–632, Jun. 2017, doi: 10.1016/j.jclepro.2017.03.146.
[101] P. Huang, V. Castán Broto, and L. K. Westman, "Emerging dynamics of public participation in climate governance: A case study of solar energy application in Shenzhen, China," *Environmental Policy and Governance*, vol. 30, no. 6, pp. 306–318, Nov. 2020, doi: 10.1002/eet.1886.
[102] M. Kalina, J. Ò. Ogwang, and E. Tilley, "From potential to practice: rethinking Africa's biogas revolution," *Humanit Soc Sci Commun*, vol. 9, no. 1, p. 374, Oct. 2022, doi: 10.1057/s41599-022-01396-x.
[103] P. Pandey and A. Sharma, "Knowledge politics, vulnerability and recognition-based justice: Public participation in renewable energy transitions in India," *Energy Res Soc Sci*, vol. 71, Jan. 2021, doi: 10.1016/j.erss.2020.101824.
[104] M. Cotton and P. Devine-Wright, "NIMBYism and community consultation in electricity transmission network planning," in *Renewable Energy and the Public. From NIMBY to Participation.*, 1st Edition., P. Devine-Wright, Ed., Routledge earthscan, 2011, pp. 115–129.
[105] C. Manktelow, T. Hoppe, K. Bickerstaff, A. Itten, M. Fremouw, and M. Naik, "Can co-creation support local heat decarbonisation strategies? Insights from pilot projects in Bruges and Mechelen," *Energy Res Soc Sci*, vol. 99, p. 103061, May 2023, doi: 10.1016/j.erss.2023.103061.
[106] P. Pandey and A. Sharma, "Knowledge politics, vulnerability and recognition-based justice: Public participation in renewable energy transitions in India," *Energy Res Soc Sci*, vol. 71, p. 101824, Jan. 2021, doi: 10.1016/j.erss.2020.101824.
[107] C. Fraune and M. Knodt, "Challenges of Citizen Participation in Infrastructure Policy-Making in Multi-Level Systems—The Case of Onshore Wind Energy Expansion in Germany," *European Policy Analysis*, vol. 3, no. 2, pp. 256–273, Sep. 2017, doi: 10.1002/epa2.1022.
[108] A. Battaglini, N. Komendantova, P. Brtnik, and A. Patt, "Perception of barriers for expansion of electricity grids in the European Union," *Energy Policy*, vol. 47, pp. 254–259, Aug. 2012, doi: 10.1016/j.enpol.2012.04.065.
[109] S. Fast, "Assessing public participation tools during wind energy siting," *J Environ Stud Sci*, vol. 7, no. 3, pp. 386–393, Sep. 2017, doi: 10.1007/s13412-016-0419-0.
[110] T. Scottish Government, "Scottish Government Good Practice Principles for Community Benefits from Onshore Renewable Energy Developments Scottish Government Good Practice Principles for Community Benefits from Onshore Renewable Energy Developments 2 CONTENTS," 2019.
[111] ThEGA - Thüringer Energie- und GreenTech-Agentur, "Faire Windenergie Thüringen," https://www.thega.de/themen/erneuerbare-energien/servicestelle-windenergie/service-fuer-kommunen/.
[112] Victoria State Government, "Community Engagement and Benefit Sharing in Renewable Energy Development in Victoria. A guide for renewable energy developers.," 2021. Accessed: Nov. 03, 2023. [Online]. Available: https://www.energy.vic.gov.au/__data/assets/pdf_file/0026/580625/community-engagement-and-benefit-sharing-guide.pdf
[113] Irish Government, "Projects of Common Interest Manual of Permit Granting Process Procedures on Guidelines for Trans-European Energy Infrastructure," 2019.

[114] EirGrid, “Community Benefit Policy,” 2022. Accessed: Nov. 07, 2023. [Online]. Available: https://www.eirgridgroup.com/site-files/library/EirGrid/209130-EirGrid-Community-Benefit-Policy-A4-Report-final.pdf
[115] UK Government, “Net Zero Strategy: Build Back Greener,” 2021.
[116] Great Britain. HM Government. and Great Britain. Department for Energy Security and Net Zero., *Powering up Britain : The Net Zero Growth Plan.* www.gov.uk/official-documents, 2023. Accessed: Nov. 03, 2023. [Online]. Available: https://assets.publishing.service.gov.uk/media/6194dfa4d3bf7f0555071b1b/net-zero-strategy-beis.pdf
[117] R. J. Citation Heffron and P. Haynes, “Challenges to the Aarhus Convention: Public Participation in the Energy Planning Process in the United Kingdom,” 2014. [Online]. Available: www.jcer.net
[118] UNECE, “Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (Aarhus Convention).” Aarhus, Denmark, 1998.
[119] European Commission, “DIRECTIVE 2011/92/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment,” 2011.
[120] European Union, “REGULATION (EU) 2022/869 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 30 May 2022 on guidelines for trans-European energy infrastructure, amending Regulations (EC) No 715/2009, (EU) 2019/942 and (EU) 2019/943 and Directives 2009/73/EC and (EU) 2019/944, and repealing Regulation (EU) No 347/2013,” 2022.
[121] European Commission, “DIRECTIVE 2011/92/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment,” 2011.
[122] Canada Energy Regulatory, “Consultation and Engagement.” Accessed: Nov. 07, 2023. [Online]. Available: https://www.cer-rec.gc.ca/en/consultation-engagement/
[123] Danish Government, “Promotion of Renewable Energy Act,” 2008, Accessed: Nov. 07, 2023. [Online]. Available: https://ens.dk/sites/ens.dk/files/Vindenergi/promotion_of_renewable_energy_act_-_extract.pdf
[124] Mecklenburg-Vorpommern, “Gesetz über die Beteiligung von Bürgerinnen und Bürgern sowie Gemeinden an Windparks in Mecklenburg-Vorpommern (Bürger- und Gemeindenbeteiligungsgesetz - BüGembeteilG M-V).” 2016. Accessed: Nov. 07, 2023. [Online]. Available: https://www.landesrecht-mv.de/bsmv/document/jlr-WindPB%C3%BCGemBGMVV1P1/part/X
[125] K. Rottmann, B. Kolboske, L. Devarti, and D. Baum, “Recommendations on Transparency and Public Participation in the Context of Electricity Transmission Lines,” 2013.
[126] The Government of Ireland, “Terms and Conditions for the First Offshore Wind RESS Competition ORESS 1,” 2022. Accessed: Jul. 31, 2023. [Online]. Available: https://assets.gov.ie/239377/556f7efc-b401-40d8-b1d8-bc8785527286.pdf
[127] The Dutch Government, “The Dutch Climate Agreement,” 2019.
[128] The UK Government, “Localism Act 2011.” Accessed: Nov. 07, 2023. [Online]. Available: https://www.legislation.gov.uk/ukpga/2011/20/part/6/chapter/3/enacted

[129] The UK Government, “Planning Act 2008: Guidance on the process for carrying out a review of existing National Policy Statements.”
[130] The UK Government, “Infrastructure Planning Comission Guide to its Role and Operation.,” 2009. Accessed: Nov. 07, 2023. [Online]. Available: https://infrastructure.planninginspectorate.gov.uk/wp-content/uploads/2009/11/The-IPC-A-guide-to-its-Role-and-Operations.pdf
[131] L. Späth and A. Scolobig, “Stakeholder empowerment through participatory planning practices: The case of electricity transmission lines in France and Norway,” *Energy Res Soc Sci*, vol. 23, pp. 189–198, Jan. 2017, doi: 10.1016/j.erss.2016.10.002.
[132] L. Späth, “Large-scale photovoltaics? Yes please, but not like this! Insights on different perspectives underlying the trade-off between land use and renewable electricity development,” *Energy Policy*, vol. 122, pp. 429–437, Nov. 2018, doi: 10.1016/j.enpol.2018.07.029.
[133] E. D. Fournier, F. Federico, R. Cudd, and S. Pincetl, “Building an interactive web mapping tool to support distributed energy resource planning using public participation GIS,” *Applied Geography*, vol. 152, p. 102877, Mar. 2023, doi: 10.1016/j.apgeog.2023.102877.
[134] K. Kokkonen and V. Ojanen, “From opportunities to action - An integrated model of small actors’ engagement in bioenergy business,” *J Clean Prod*, vol. 182, pp. 496–508, May 2018, doi: 10.1016/j.jclepro.2018.02.013.
[135] K. H. Zemo and M. Termansen, “Farmers’ willingness to participate in collective biogas investment: A discrete choice experiment study,” *Resour Energy Econ*, vol. 52, pp. 87–101, May 2018, doi: 10.1016/j.reseneeco.2017.12.001.
[136] A. Santos *et al.*, “Public Participation in Renewable Energy Infrastructure Projects. A comparison between the Copenhagen and Malmø Regions.,” 2012.
[137] A. S. Maqbool, E. van der Waal, and H. van der Windt, “‘Luctor et emergo’, how a community energy initiative survived the changing policy and technology landscape of the Dutch energy system?,” *Energy Policy*, vol. 177, p. 113528, Jun. 2023, doi: 10.1016/j.enpol.2023.113528.
[138] H. Solman, M. Smits, B. van Vliet, and S. Bush, “Co-production in the wind energy sector: A systematic literature review of public engagement beyond invited stakeholder participation,” *Energy Research and Social Science*, vol. 72. Elsevier Ltd, Feb. 01, 2021. doi: 10.1016/j.erss.2020.101876.
[139] J. B. Jacquet, “The Rise of ‘Private Participation’ in the Planning of Energy Projects in the Rural United States,” *Soc Nat Resour*, vol. 28, no. 3, pp. 231–245, Mar. 2015, doi: 10.1080/08941920.2014.945056.
[140] I. Soutar *et al.*, “Constructing practices of engagement with users and communities: Comparing emergent state-led smart local energy systems,” *Energy Policy*, vol. 171, Dec. 2022, doi: 10.1016/j.enpol.2022.113279.
[141] M. Aitken, “A three-dimensional view of public participation in Scottish land-use planning: Empowerment or social control?,” *Planning Theory*, vol. 9, no. 3, pp. 248–264, Aug. 2010, doi: 10.1177/1473095210366193.
[142] Hagget, “The principles, procedures, and pitfalls of public engagement in decision-making about renewable energy,” in *Renewable Energy and the Public. From NIMBY to Participation*, 1st Edition., P. Devine-Wright, Ed., Routledge earthscan, 2011, pp. 15–28.

[143] R. Bull and W. Eadson, “Who has the power? Reflections on citizen engagement in district heating schemes in the UK and Sweden,” *Energy Policy*, vol. 177, p. 113505, Jun. 2023, doi: 10.1016/j.enpol.2023.113505.
[144] R. Berry, G. Higgs, R. Fry, and M. Langford, “Web-based GIS Approaches to Enhance Public Participation in Wind Farm Planning,” *Transactions in GIS*, vol. 15, no. 2, pp. 147–172, Apr. 2011, doi: 10.1111/j.1467-9671.2011.01240.x.
[145] S. Owens and L. Driffill, “How to change attitudes and behaviours in the context of energy,” *Energy Policy*, vol. 36, no. 12, pp. 4412–4418, Dec. 2008, doi: 10.1016/j.enpol.2008.09.031.
[146] J. B. Jacquet, “The Rise of ‘Private Participation’ in the Planning of Energy Projects in the Rural United States,” *Soc Nat Resour*, vol. 28, no. 3, pp. 231–245, Mar. 2015, doi: 10.1080/08941920.2014.945056.
[147] K. Rottman, “Recommendations on Transparency and Public Participation in the Context of Electricity Transmission Lines,” 2013.
[148] C. Fraune and M. Knodt, “Challenges of Citizen Participation in Infrastructure Policy-Making in Multi-Level Systems-The Case of Onshore Wind Energy Expansion in Germany,” *European Policy Analysis*, vol. 3, no. 2, pp. 256–273, Oct. 2017, doi: 10.1002/epa2.1022.
[149] R. Berry and G. Higgs, “Gauging levels of public acceptance of the use of visualisation tools in promoting public participation; a case study of wind farm planning in South Wales, UK,” *http://dx.doi.org/10.1080/09640568.2011.591925*, vol. 55, no. 2, pp. 229–251, Mar. 2012, doi: 10.1080/09640568.2011.591925.
[150] J. Chilvers, R. Bellamy, H. Pallett, and T. Hargreaves, “A systemic approach to mapping participation with low-carbon energy transitions,” *Nat Energy*, vol. 6, no. 3, pp. 250–259, Mar. 2021, doi: 10.1038/s41560-020-00762-w.
[151] P. Huang, V. Castán Broto, and L. K. Westman, “Emerging dynamics of public participation in climate governance: A case study of solar energy application in Shenzhen, China,” *Environmental Policy and Governance*, vol. 30, no. 6, pp. 306–318, Nov. 2020, doi: 10.1002/eet.1886.
[152] N. Komendantova, L. Ekenberg, L. Marashdeh, A. Al Salaymeh, M. Danielson, and J. Linnerooth-Bayer, “Are energy security concerns dominating environmental concerns? Evidence from stakeholder participation processes on energy transition in Jordan,” *Climate*, vol. 6, no. 4, Dec. 2018, doi: 10.3390/cli6040088.
[153] S. Fink and E. Ruffing, “Learning in iterated consultation procedures – The example of the German electricity grid demand planning,” *Util Policy*, vol. 65, Aug. 2020, doi: 10.1016/j.jup.2020.101065.
[154] D. Stober, M. Suškevičs, S. Eiter, S. Müller, S. Martinát, and M. Buchecker, “What is the quality of participatory renewable energy planning in Europe? A comparative analysis of innovative practices in 25 projects,” *Energy Res Soc Sci*, vol. 71, Jan. 2021, doi: 10.1016/j.erss.2020.101804.
[155] D. Süsser, A. Ceglarz, V. Stavrakas, and J. Lilliestam, “COVID-19 vs. stakeholder engagement: the impact of coronavirus containment measures on stakeholder involvement in European energy research projects,” *Open Research Europe*, vol. 1, p. 57, 2021, doi: 10.12688/openreseurope.13683.1.
[156] J. E. Innes and D. E. Booher, “IURD Reprint Series Title Reframing Public Participation: Strategies for the 21st Century Publication Date,” 2005.

[157] 50Hertz, “How it works: overhead lines,” 2020. Accessed: Aug. 30, 2023. [Online]. Available: file:///C:/Users/diana/Downloads/50Hertz_Broschuere_Stromautobahnen_Freileitungen_2020_EN.pdf

ANNEX 1: Literature review approach

The researchers used several search engines and academic databases, including Google Scholar, Google Search, Scopus and Web of Science as search engines. **Table 7** overleaf summarizes the exclusion and inclusion criteria of the literature review. The review was split into two parts: Part I focused on the drivers and barriers, and Part II focused on the formats and methods. Different search strings have been applied, for example: “public participation” OR “stakeholder participation” AND “transmission lines” OR “distribution lines”, and “drivers” OR “barriers” OR “challenges” AND “public participation” OR “stakeholder participation” AND “energy transition” OR “energy infrastructure”. The abstracts of the matching articles were reviewed for its relevance to the study context, and articles that were outside of the study scope excluded[6].

The researchers developed two frameworks for the analysis of the literature (for Parts I and II). The analysis of drivers and barriers was structured along the kinds of technologies and country contexts, different kinds of drivers and barriers for both participation and acceptance, as well as measures proposed to overcome challenges. The analysis of formats and methods was structured into the type of energy infrastructure, ownership structures, regulatory requirement for public participation, process-leading organization, participating groups, formats/methods of participation, participation outcomes, and benefits derived from the process.

Table 7: Inclusion and exclusion criteria of the literature review

Inclusion criteria	Exclusion criteria

• Year of study: from 2000-2023
• Scientific and grey literature, e.g., journals, conference papers, book chapters.
• Literature is available in English language.
• Include the search strings:
  - related to the barriers and drivers,
  - related to formats and methods to engage the public in energy infrastructure.
	• Public participation is not related to energy infrastructure.
	• Not relevant for the types of energy infrastructures of the current UserTCP’s project.
	• Journals or books not accessible online.

[6] We excluded articles that missed the project scope, such as papers that dealt with public engagement in nuclear energy, or nuclear gas, for example.

ANNEX 2: Interview guideline

INTERVIEW QUESTIONNAIRE
Introduction:

- **Quick intro of yourself and IEECP/RGI to the interviewee.**
- **Background of the study and its aim:** The study is conducted in the context of the "Public engagement for energy infrastructure" Task by Users-centred Energy Systems by the IEA. The task looks at effective public engagement in energy infrastructure projects. With the interviews, we want to investigate drivers and barriers of public engagement, as well as good practices of a successful participation in energy infrastructure. When we talk about energy infrastructure, we specifically mean energy production systems, such as wind turbines, solar panels, or biomass plants, and electricity grids, but you can also elaborate on assisting technologies, such as storage technologies or green hydrogen production systems. The results of the study will feed into a best practice guideline for practitioners and policymakers.
- **Data protection:** Thank you for agreeing to take part in this interview, which should last maximum one hour. Your participation in this interview is voluntary and you can change your mind at any time. The information that you provide will be treated in confidence by the research team. By conducting this interview, you are consenting to collection and processing of personal data for research purposes, which I sent you beforehand. Do you have any questions regarding that? We would like to record the discussion for analysis purposes, which will be used to help us accurately collect findings for the research. The recordings will be securely stored and retained by us and destroyed after the completion of the research. Are you happy for us to proceed?
- **I'll start the recording of our meeting now.**

Question for Member States-level actors only; Questions to EU or international experts only; Questions for the industrial/business interviewees; Note: an additional question might be added depending on the specific interview partner.

#	Question	Area of investigation / remark
0	Can you briefly explain me, what is your role at your organisation?	*Inro /About you*
1	When you hear the term "public engagement". What does it mean to you?	*Meaning public participation*
2	What do you think are the different ways the public should be engaged in energy infrastructure developments?	*Ways of participation*
3	Do you think it is important for the public to participate in energy infrastructure developments? And if yes, why would you say so?	*Purpose of participation*

	If they respond no: Why not?	
4a	In COUNTRY, are there mandatory or voluntary requirements, such as laws or guidebooks, for public engagement on energy infrastructure projects? If so, what are those requirements and for what technologies. *Follow up questions, if not addressed:* - Why do you think there are requirements for X and Y and not for other technologies?	*Legal frameworks*
4b	If you think about different country contexts, are you aware of any mandatory or voluntary requirements in specific countries that you think are important to enable effective participation in energy infrastructure?	*Legal frameworks*
5a	What do you perceive as the main drivers, or motivating factors, for the public to engage with energy infrastructure developments? *Follow up questions, if not addressed:* - Can you think of other factors that could motivate individuals or groups to become or stay engaged? - Can you think of other drivers that come from the broader national context and legal and institutional environment, such as the enabling frameworks, or culture of participation? - Do you think that the current regulatory frameworks allow for a meaningful stakeholder engagement? If yes, why do you think so?	*Drivers*
5b	Do you think that the current organisational structure of your company helps to progress with a meaningful stakeholder engagement? Why? What shall be improved? *Follow up questions, if not addressed:* - Are there any internal policies in your organisation that promote sustained engagement with stakeholders? Could you elaborate? - What went well in engaging the public when running your daily business/implementing your project? And why would you say so? - Would you call that a driver?	*Drivers*

6a	Now let's move from drivers to barriers: What do you perceive as the main barriers to public engagement in energy infrastructure? *Follow up questions, if not addressed:* - Can you think of other barriers preventing individuals or groups from participating? - Can you think of other barriers that come from the broader national context and legal and institutional environment, such as the importance devoted to public participation in policymaking in general, or regulations and laws in place? - How do you think should policy or legal frameworks be designed to enable participation?	*Barriers*
6b	When running your daily business/ implementing your project, what, if anything, is missing when it comes to involving the public? Is there anything holding you back? - Would you call that a barrier? - If applicable: how could this barrier (or these barriers) be overcome?	*Barriers*
6c	Can you think of any examples you have experienced in your work, where public opposition to energy infrastructure developments was/is a barrier? - If applicable: do you think public opposition to, or protests against, energy infrastructure developments are different from other types of infrastructure? *Follow-up, if applicable:* to what extent do you think it's different?	*Barriers - example*
7	What do you think are suitable formats or methods for engaging the public? Can you first name different formats and then we will discuss each of them. *Follow up questions:* - At which stage, or stages, of the project's development do you find it the most important to engage the public? - Why would you suggest applying method X, and what point in time? And who should lead the engagement process? OR Why would you apply method X and at what point in time? - What should specifically be achieved with such method?	*Formats / methods / objectives* *Why and when* *Justice aspects* *Levels of participation* *Justice aspects*

	- What format or formats, do you think, are most inclusive in terms of participation and lead to fair energy infrastructure developments? And why would you say so? - After the COVID-19 outbreak many of the engagement formats moved online. How would you assess that this shift impacted a successful stakeholder engagement?	
8	If applicable, please could you tell me about one specific energy infrastructure project - in which you have been involved in, or that you are aware off - that you would say was successful in terms of how the public has been engaged? - How was the public effectively engaged within the project? What methods were used? - Were community benefits offered to the public, and how was the effect on the acceptability of the project? - If you reflect on the project process, what were the key success factors of the effective public engagement? - If you reflect on the project outcomes, to what extent do you think the public engagement has led to different outcomes than originally anticipated? Were these outcomes better or worse?	*Good practice*
9	What would be one key takeaway message that you think is the most important thing that people should consider when engaging with the public on energy infrastructure projects?	*Take away*
10	Is there anything else relevant to the research that we did not already discuss? Is there anything else that you would like to add?	*Closing*
11	Can you recommend another person I should contact regarding the topic?	*Contacts*
12	We will analyse the interview according to the GDPR and confidentiality requirements. Do you want to be informed about the outcomes of the research?	*Further involvement: Results reporting*
13	We plan to conduct an online expert workshop on the topic in autumn/winter. Would you like to be invited to the workshop?	*Further involvement: Workshop*

14	We plan to develop a best practice guide for public participation. Would you like to be contacted to give feedback on the guideline?	*Further involvement: Guideline*

Thank you very much for the interview!

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