Advances in Reliability, Safety and Security, Part 10 – Kołowrocki, Kosmowski (eds.)
 ISBN 978-83-68136-22-7 (printed), ISBN 978-83-68136-09-8 (electronic)

Advances in Reliability, Safety and Security

ESREL 2024
Monograph Book Series

Contribution Of Risk Science To Wind Power Policy Making In Norway: Study Of Stakeholder Involvement In Risk Communication Of Onshore Wind Farms

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Abstract

The development of wind farms as a major source of renewable energy has received increased attention in Norway. It is set to become a key component of the country's energy policy mix. In recent decades, significant investments and efforts have been made to understand and address affected stakeholders' concerns. A question is whether these efforts have been consistent with risk science, in particular, whether they capture the perceptions of risks and uncertainties about wind farm development. Despite these efforts, opposition to the development is still ongoing at the local level. Systematic research into stakeholders' preferences suggests that there is room for improvement in the practice of risk communication. Institutional actors should properly recognize and involve local people. They should also establish active communication strategies that target affected residents. In the present paper, we examine the current practices of wind farm risk and uncertainty communication in Norway and present the current perspectives based on stakeholder analysis. This includes an in-depth discussion of the issue, from a risk science and risk communication perspective. Recommendations include how to tackle the challenges and improve the practices of wind farm risk communication which can contribute to improving the quality of energy safety policy.

Keywords: risk communication, risk perception, stakeholders' involvement, renewable energy, wind farm

1. Introduction

In February 2023, a group of young Sami climate activists were standing in the lobby of the Norway Ministry of Oil and Energy in Oslo (The Local Norway, 2023). They protested against wind turbines in two of the largest Norwegian wind farms in Fosen, Storheia, and Roan. Their message was clear: they wanted to see the wind turbines demolished. They were acting in support of reindeer owners from the Fosen district, who believed that the wind turbines would have negative impacts on the reindeer husbandry and the grazing areas (NRK, 2023). Opposition to wind power linked to alleged risk and negative impacts is not unprecedented in Norway (Motvind, 2021). Some local populations were/are mainly concerned about the negative consequences of the turbines on nature, visual disturbance, and generated noise. They believe that this issue is not adequately investigated.

The opposition happened despite the Norwegian Government's efforts to reduce local conflicts and foster consultation about perceived environmental and social impacts. In 2019, the Directorate of Water Resources and Energy (NVE) established a national framework for wind power as a central part of this effort. The framework commits to selecting the most suitable areas and basing action on relevant knowledge that takes into account environmental and social impacts. Yet, the process has resulted in more friction and opposition. In response to the proposed framework, 49 municipalities out of 56 said no to the wind turbines in their municipality (NRK, 2019). The Government's response has been to suspend the proposed framework.

These ongoing conflicts suggest a lack of effective communication about the risks and benefits of wind power plants. On one hand, the Government (as the main institutional risk communicator) is sending messages on how the related risks and uncertainties are managed. Many stakeholders (e.g., the public and municipalities), however, remain unconvinced and do not find answers to their concerns. An essential question then arises as to why the provisions of the national framework are insufficient for handling relevant risks and uncertainties. Is the

framework fit for purpose when it comes to risk communication? In particular, does it address the stakeholders' concerns about specific risks and uncertainties with meaningful messages that provide satisfactory answers?

Answering these essential queries may contribute to forming a proper risk communication framework. An essential component of a functioning risk communication approach is to ensure that risk perception and stakeholders' concerns are properly reflected upon. It is also more likely to lead to more effective and widely accepted risk policies. The effective communication of risk and uncertainties is the core of every successful risk management approach. Its purpose is to build a bridge between professional risk judgements (of experts and decision-makers) and the perceptions and concerns of the public (Renn, 2008).

The present paper offers a systematic analysis of these issues in the context of the Norwegian wind turbine controversy. We analyze the course of development of events and policies of onshore wind farms in light of contemporary developments in risk science, especially risk communication.

The paper is organized as follows. Section 2 briefly returns to fundamental discussions about risk and uncertainty communication, as well as providing contrasted examples and lessons from the field of energy infrastructure. Section 3 elicits the methodology followed in this study. Section 4 presents its results. Issues and challenges for risk and uncertainty communication are discussed in Section 5. Section 6 provides recommendations for improvement of the risk communication practices. The final section (7) provides some conclusions.

2. Background review

2.1. Risk communication: a practice in need of involvement of stakeholders

The field of risk communication has emerged from the rich corpus of work developed by scholars with contrasting interests, knowledge, and research traditions (Balog-Way et al., 2020). Within Risk Science, the prevailing view is that risk communication can be defined as the "exchange or sharing of risk-related data, information, and knowledge between and among different target groups such as regulators, stakeholders, consumers, media, general public" (Aven, 2019, p.38).

Risk communication has its origin in risk perception studies (Slovic, 1987, 1993, 2010), described as a "person's subjective judgment or appraisal of risk" (Aven, 2019, p. 38). According to risk perception research, the public ranks the riskiness of specific hazards in a way that does not match probabilistic estimates (Fischhoff et al., 1978). This extends to the field of energy where, for instance, nuclear activities have been seen as 'dread' (Slovic, 1987). In addition, judgement is also affected by biases and heuristics (i.e., 'mental shortcuts') (Tversky and Kahneman, 1974; Rohrmann and Renn, 2000; Renn, 2008) and emotions and affect (Finucane et al., 2000; Slovic et al., 2004, 2007). These complex factors influence how people process risk messages and form opinions and decisions in the face of risk and uncertainty.

A take home lesson from these studies is that they show a marked difference between expert and lay perception of risk (for a detailed discussion see Balog-Way et al., 2020). Against this backdrop, science-informed risk communication programs have been introduced from the 1980s onwards as an attempt to bridge the gap between expert and lay perceptions, especially in the energy sector, more specifically nuclear technology. Almost thirty years ago Fischhoff (1995) and Leiss (1996) suggested that the field of risk communication had undergone several evolutionary stages over the first few decades of its existence. A shorter version of Leis (1996), contains three developmental phases:

- Phase 1: The necessity of conveying probabilistic thinking to the general public and to educated lay audiences;
- Phase 2: The persuasion of audiences and the management of public relations to convince people that some of their behavior is inappropriate;
- Phase 3: Two-way communication process in which scientists, risk managers, and various laypersons engage in a social learning process.

This approach is also consistent with earlier versions that have conceptualized risk communication as "multiple messages about the nature of risk and other messages, not strictly about risk, that express concerns, opinions or reactions to risk messages or to legal and institutional arrangements for risk management" (NRC,1989, p.21). Yet, actual practice may be lagging behind. Ten years ago, Kasperson (2014) noted that:

"Over the past nearly 30 years, a flood of work on risk communication initiatives and analyses has appeared. And yet the practice of risk communication by corporations, federal agencies, and ideal government in many respects seem little changed from practice decades ago" (Kasperson, 2014, p.1233).

In other words, institutional communicators have largely failed to pick the fruits of effective risk communication. Ten years later, large-scale experiments in risk communication such as COVID-19 and the

Energy and Climate debate suggest that the most basic, yet common, form of expert-led risk communication is still resting on information and persuasion. In other words, institutional communicators are often stuck at early development stages (Fischhoff, 1995), oscillating between phase 1 and phase 2 of the Leiss model. By contrast, effective and mature risk communication (phase 3) of the two-way, or multiway (Balog-Way et al., 2020) format requires 'proactive' engagement, i.e., the communicators/institutions take the initiative of reciprocal and effective interactions with other stakeholders and while doing so maintain trust in the process and avoid information vacuums (Löfstedt, 2005).

Risk communication has also advanced based on research in social psychology about collective behavior in the face of risk and uncertainty. A crucial advancement from this perspective is the study of the dynamics and mechanisms that lead the risk communication process to build trust or distrust in institutions (Löfstedt, 2005). Löfstedt also points to the potential for distortion that the 24/7 news media environment creates. In this regard, a social amplification and attenuation of risk (SARF) framework was developed (Kasperson et al., 1988; Pidgeon et al., 2003) exploring the stations and ripple effects that risk messages undergo when interacting with psychological, social, cultural, and institutional factors. This process, in which the mass media play a great role, may lead to "more or less amplification or attenuation" of perceived risks (Kasperson and Kasperson, 2005, p. 107). SARF offers a convincing approach to capture the complexity of the communication process.

The two-way/multiway communication process is essential to dampen the social amplification of minor risks (Fischhoff, 1995), facilitating comprehension of the attitudes and mental representations of those involved in the risk communication process, i.e., the risk perception of the involved groups (Fischhoff et al., 1993). Through a two-way/multiway risk communication process, risk managers and policymakers find the opportunity to learn from the stakeholders and the target audience about their specific concerns, their feelings about risk, and the way they perceive risk.

Stakeholders' involvement and participation in risk-related decisions is one of the major objectives of risk communication (Balog-Way et al., 2020) providing the opportunity for all involved stakeholders to participate in the risk appraisal and reflect on their concerns in risk decision-making. A distinction should be made between: a) stakeholders as socially organized groups who are either affected by or have a strong interest in the outcome of the risk-related event, b) directly affected public as individuals and non-organized groups who will be affected by positive or negative impacts from the outcome of the risk-related event, c) observing public such as the media and opinion leaders who may influence public opinion by (not) commenting on the risk issue, and d) general public who are not directly influenced by the risk and are part of the public opinion on the issue (Renn, 2008). Risk preferences greatly vary, not only between these groups of stakeholders but also inside each group. For effective risk communication and governance, it is vital to consider the varying types of knowledge and plurality of values existing in these groups.

To date, the mixed outcomes (Kasperson, 2014) of various risk communication practices in different sectors (e.g., energy, food, or healthcare), have shown the significance of engagement with stakeholders as well as reflecting their concerns about the failure or success of risk handling. "Scarcity of attitudes and aptitudes" (Webler and Tuler., 2020, p.505) of the public, and more broadly, different stakeholders, is suggested as a driver of unfulfilled promises and distrust in risk-related decision-making. In this regard, there are various examples of failed or successful practices of risk communication in energy infrastructure projects. Following, we will provide a short review of contrasted practices from Sweden showing the significance of the quality of the stakeholders' engagement for the outcome of infrastructure projects.

2.2. Bioenergy siting in Sweden: Växjö vs Lund

Sweden has been a pioneer in green bioenergy. In 1996, Löfstedt developed an exploratory case study about the adoption of Biomass in the city of Växjö (Småland). The results showed that a combination of monetary and social factors helped to make biomass commercially viable. In particular, Löfstedt looked into the factors that contributed to the social acceptability of biomass. Among the more important reasons, he identified a supportive public, economic subsidies from the Swedish State, a large resource base, a collaborative city council, and a forward and innovative management at the utility owning the biomass district heating plant. Nonetheless, Biogas plants may also raise concerns due to the risk of unpleasant odors. In the case of the Lund (Skåne) biogas plant, issues extended to potential negative impacts on the community and environment (Khan, 2004). In January 2000, despite the progress for more than 4 years, the proposed plant was stopped due to heavy opposition from the local public, based on a decision by a political majority in the municipality of Lund.

The specific stakeholders included the developer, the municipality of Lund, the local group (the neighboring residents), the county administration (issued the environmental permit), and the local population who were strongly against the plant site. In this case, however, the multistakeholder interactions did not lead to greater public acceptance. Based on the idea that it would make the planning process more efficient, the developer

included only experts and beneficiary stakeholders (e.g., farmers) in the early planning phase. Other stakeholders, i.e., the local population, political representatives, and environmental organizations, were not involved. The developer made the final decision for siting selection at the end of 1997. Prompted by the Environmental Protection Act, public involvement only began in 1998 in an informative meeting while the application phase had started. There was no possibility to address public concerns in the planning despite the neighbors' numerous questions and comments. Neither did the developer show any intention of further informational activities. They also behaved as if the final decision had already been made. This turned into a negative perception that the developer wanted to exclude the public from the process, and that the information provided was neither comprehensive nor objective (Khan, 2004).

After this meeting, the opposition started first among neighbors and the residents, who also encouraged public opposition as well as put pressure on decision-makers. The opposition group was very active in criticizing the biogas plant (Khan, 2004). It involved local newspapers, collected signatures for a petition, organized public meetings, and had door-to-door discussions with people in Dalby. Despite organizing an information meeting with the residents in November 1998 and submitting supplementary information and a detailed plan, the opposition went into a new intensive phase at the end of 1999. In this context, the political majority of the planning committee decided not to allow a detailed plan to be made. In other words, the project neither followed a good risk communication practice nor due legislative process. It was finally stopped for political reasons.

2.3. Effective risk communication: effective stakeholder engagement

As shown in the bioenergy cases, it is important to ensure that stakeholders' engagement is based on effective principles of risk communication. A functioning process of stakeholder involvement should seek to provide balanced information and policy framings to stakeholders, create and maintain space for deliberation and diverse forms of involvement and reflection, avoid simplistic strategies for stakeholder sampling, and use various approaches to elicit broader values (Pidgeon, 2020). Incorporating stakeholders and public participation and deliberation is a continuum ranging from low to high involvement, which can make the engagement challenging (Balog-way et al., 2020). To meet these factors, we provide seven key recommendations from a risk communication perspective:

1) Being committed to going beyond narrowly defined scientific and technical solutions, which typically ignore human factors
2) Identifying and engaging all key stakeholders and public groups
3) Identifying different values, concerns, and perspectives between and inside each group of public and stakeholders
4) Developing adaptative strategies for stakeholders' engagement that account for the level of risk debates and the type of risk
5) Ensuring good timing when engaging with the stakeholders
6) Ensuring frequent dialogue between different stakeholders as required
7) Making sure that institutional communicators have reliable knowledge and expertise about risk issues

3. Case selection and methods

Norway's onshore wind farms present a relevant case study. The country is a major energy nation in Europe and is one of the world's largest producers and exporters of oil and gas. Yet, Norway is also a heavy producer and exporter of renewable energy to Europe, including the Nordic countries. The energy consumption inside the country is in the form of electricity, where 95% of the production comes from renewable energy sources, mainly from hydro- and wind power sources (NVE, 2023c). There is, however, an apparent discrepancy between Norway's global standing as an energy giant/ pioneer in the green transition and the level of popular resistance to the smooth execution of this transition. According to the International Energy Agency (IEA), "Norway has the highest share of electricity produced from renewable sources in Europe and the lowest carbon emissions intensity from the power sector" (IEA, 2022, p. 41), yet it "has faced local opposition to onshore wind power projects, based on the perceived impact on landscapes and ecology" (IEA, 2022, p.12). The country's commitment to the NetZero emissions targets by 2050 and its adherence to democratic values, that necessitate addressing citizen concerns, make it necessary to adopt a valid communication framework. This framework should be capable of bridging the gap and properly informing both policymakers and the public about the risks and uncertainties of onshore wind farm development for better decision-making.

The case study is notably expansive and intricate. Given the breadth of the subject matter, this paper presents the results of the first step of the research in the form of a content analysis that explores the chain of events

leading up to the controversy. The corpus is made of 17 documents namely: i) 6 articles from NRK, Nettavisen, E24, The Local Norway, and TU newspapers, ii) 5 governmental documents from the web portal of the Government of Norway, iii) 6 reports and documents from the Norwegian Water Resources and Energy Directorate (NVE). The selection of these documents is based on their relevance to the core issues addressed in the introduction following a review of a broader range of documents from similar sources, which were examined to provide context and background information.

4. Wind power in Norway: background, policies, debates

To reach the NetZero emissions target in line with the Paris Agreement and under the climate agreement with the EU, Norway has committed itself to reducing CO_2 emissions by at least 55% from 1990 levels by 2030. This is to be achieved through a Climate Change Act adopted in June 2017 in the Norwegian's parliament (IEA, 2022). By 2050, Norway evolves into a low-emissions society with the objective of reducing emissions by 90-95% compared to 1990 levels (Regjeringen, 2021). Reaching such targets necessitates increasing the electrification of end uses in different sectors. It means that electricity demand will grow and that an additional zero-emissions generation capacity is required.

Wind power, after hydropower, perfectly fits the Norwegian energy policy. It presents significant potential for a sustainable, profitable, and climate-friendly energy generation capacity: Norway's geography provides some of the best wind resources in Europe, both on- and offshore. Other encouraging factors for exploiting wind power sources include efficiency gains from more robust turbines with longer lifespans. These will achieve decreasing costs of electricity production and technological developments.

In recent decades, Norway has invested significantly in the development of wind farms and wind turbines across the country. The share of wind power in Norway's electricity production has had a significant increase in recent years (IEA, 2022). According to Norway's Directorate of Water Resources and Energy (NVE), 1392 wind turbines in 65 wind parks came into operation up until 18 October 2022 (NVE, 2022a). NVE estimates the generation of 16.9 TWh of electricity from wind power in 2023, accounting for approximately 11% of the share of the normal annual production from renewable sources, positioning wind power as the second-largest electricity source in the country (NVE, 2023b).

In line with Norway's energy policy toward 2030, the Norwegian Ministry of Petroleum and Energy mandated the NVE in February 2017 to propose a national framework for onshore wind power. The explicit objective of this framework was to facilitate the sustainable and profitable development of wind power (Regjeringen, 2017). The need was also based on experience in relation to the mandatory electricity certificate scheme, where many license applications for onshore wind power had been processed but led to significant local conflicts and hence to a waste of resources.

The purpose of the framework, thus, was to help ensure the best wind power locations considering important environmental and social concerns and a more efficient licensing process. The proposed national framework constitutes an updated knowledge base for land-based wind power. A map was drawn suggesting 13 areas as the most suitable locations. NVE gave high priority to taking into account the environmental and societal impacts of wind power plants. For instance, 21 thematic reports were issued about the impacts on the landscape, wildlife, birds, outdoor activities, pollution, neighboring effects, etc., considered for designation and assessment of the suitable areas. These reports were also designed with a view to avoid conflicts with important interests and natural areas. According to NVE, different stakeholders and actors, such as national authorities and companies, regional and local authorities, interest organizations, and Sami stakeholders, as well as national professional authorities and knowledge communities within various areas were involved in preparing the proposed national wind power framework (NVE, 2022b).

A proposal for the national framework was presented by the NVE in 2019. However, the locals' and municipalities' negative reaction to the proposal intensified, forming stronger opposition to wind farm development in Norway. The opposition was mainly from residents and municipalities (local politicians), perceiving that their concerns were being disregarded. Residents' concerns were mainly about the negative impacts of wind farms on nature, the environment, cultural heritage, local businesses, biodiversity, and the rights of the Sami group for reindeer husbandry. Some prevalent attitudes toward the framework, particularly from environmental NGOs, reflect skepticism about the quality of this knowledge, suggesting that many granted concessions have resulted in conflicts rooted in an insufficient understanding of wind power (E24, 2019). The municipalities and local politicians, in addition, were dissatisfied. Despite their initial welcome to the wind farm, they perceived that their role as a decision-making authority has been overridden. By the proposal hearing deadline, more than 5,000 consultation responses had been submitted, with 56 municipalities responding, mostly

negatively, among which 49 municipalities clearly said no to wind turbines, while three were skeptical (NRK, 2019).

Despite this frosty reception, many licenses were granted up until the NVE proposal presentation. Subsequently, the government introduced a temporary pause in the licensing process of new applications in 2019 (IEA, 2022). It suspended the proposed national wind power framework and focused on better including local publics, municipalities, developers, interest groups, and other affected parties. In April 2022, after almost three years, the Norwegian minister of oil and Energy, Terje Aasland, announced the reopening of the licensing process for onshore wind power and asked NVE to resume new wind power projects in the municipalities that show consent (Regjeringen, 2022). However, up until November 2022, only two municipalities, Gamvik and Lebesby, showed interest in developing new wind farms (Nettavisen, 2022). As an encouragement, the Government amended onshore wind taxation to require concessionaires to pay property tax in addition to the corporation tax (NVE, 2022c), thus offering economic compensation for municipalities. This measure, however, triggered the developers to oppose the new tax regulations (TU, 2023). Furthermore, amendments in the Energy Act and the Planning and Building Act were conducted aiming at a more proactive role for local municipalities. The new amendments required area clarification before granting a license, as opposed to the prior practice where municipalities expressed their position during or after the licensing process (Regjeringen, 2020, 2023).

Today, the licensing process starts with the initiating phase, in which an actor takes the initiative to send an application to NVE for starting a wind power project. Before this phase, the developer must receive the consent of the host municipality. This duty is organised through the Planning and Building Act to ensure that local concerns are duly taken on board before launching the decision-making process. The next step is for NVE to determine the impact assessment themes that the actor must investigate in detail. The prepared impact assessment must be sent to NVE. Based on the application, impact assessments received comments, and NVE's specialist knowledge of wind power, NVE assesses the application and makes a decision. Stakeholders with a legal interest may appeal the decision. Before the project owner can start the construction, NVE must approve the environmental, transportation, and construction plan and the relevant details (NVE, 2023a).

5. Analysis: what does the case tell us?

The case of an onshore wind farm in Norway illustrates the multifaceted landscape of wind power development with a wide range of stakeholders with different values and concerns, and a complex interplay of economic, social, environmental, and political factors. Moreover, inter-stakeholder conflicts, such as internal differences in political parties or various segments of the public, add to the intricacy of addressing divergent perspectives and concerns. The main concerns revolve around, among others, utilizing onshore wind farm capacity to reach Net-Zero targets and capitalizing on international investment opportunities, environmental, cultural, financial, and economic negative impacts, and concerns about profit repatriation.

Current practices indicate a gap between the experts'/policymakers' judgment of risk and the risk perception of (some of) the stakeholders. The policymakers' endeavor to better engage different stakeholders and address their concerns failed. They provided elements, namely a national framework, adjusting policies, or introducing new regulations. Yet, with each attempt, some groups of stakeholders responded as though their concerns and values had been disregarded.

The national framework, despite its rich technical details and thematic reports, remained rather superficial in addressing the issue of risk and uncertain impacts of the onshore wind farms. Various environmental and social aspects were only addressed on a surface level. Only in a few instances, a specific risk event, e.g., ice throw, has been measured probabilistically, however, without clear definition and interpretation. Real concerns of the stakeholders, especially those coming from psychological, social, and cultural backgrounds, e.g., affect, values, knowledge, controllability of and familiarity with the risk source, were not adequately reflected.

The national framework as well as the statements of the Government explicitly indicate large uncertainties associated with the risks and poor knowledge bases. However, the current practices do not offer explicit plans for reducing uncertainties and improving the knowledge bases. In a similar way, they do not offer satisfactory mitigating measures. The practices lack a proper strategy for tackling the challenges of communicating risk and uncertainty.

Furthermore, current practices lack a clear framework that shows how the risks and uncertainties are assessed, managed, and mitigated, and what the gained benefits are. The absence of a proper risk assessment framework can result in poor risk management and communication. Furthermore, there is a lack of a concise and clear central risk message for each stakeholder, i.e., it is not clear who needs to know what.

Finally, despite the complex web of perceptions and interests derived from a multiplicity of stakeholders, the practices point to top-down communication strategies, at least with some groups of stakeholders. In other words,

institutional communication focuses on the provision of information instead of involving the stakeholders in a two/multi-way process.

6. The contribution of risk science

Contemporary risk science includes concepts, principles, approaches, methods, and models for characterization, assessment, communication, and management and governance of risk (Aven, 2019). Risk communication is a core subject in contemporary risk science (SRA, 2018), which provides state-of-the-art knowledge linking science to successful practice (Fischhoff and Scheufele, 2019). With reference to this knowledge, incorporating the risk communication criteria derived from the bioenergy cases, and the findings of the onshore wind farm analysis in Norway, we propose some recommendations applicable to onshore wind farm development in Norway:

1) Identifying and engaging all key stakeholders and public groups: this provides the opportunity to reflect on the perception and concerns of all stakeholders and groups affected by the risk decision-making. The exclusion of some groups to make the decision-making process more efficient tends to backfire, as seen in the case of biogas siting. It makes the process less efficient and perhaps unsuccessful. Furthermore, the case highlights that all affected stakeholders must be engaged, not only the ones who benefit from the project.
2) Identification of different values, concerns, and perspectives between and inside each group of public and stakeholders: risk perception greatly varies, not only between different groups of public and stakeholders but also inside each group. It is vital to consider the varying types of knowledge and plurality of values existing in these groups (Renn, 2008), which influence the quality of stakeholders' involvement and the effectiveness of the risk communication process.
3) There is a gap between professional judgments of risk and public risk perception: lay people's risk perception includes affect, values, and fears, while technical/probabilistic risk assessment, used by experts and decision-makers, cannot address these factors. To bridge this gap, a broader perspective, i.e., uncertainty risk perspective, on risk is required. It can enable policymakers to consider the public's perceived risk in their decision-making, planning, and resource allocation (Aven, 2019).
4) Good risk communication cannot be seen as isolated from a good risk assessment framework (Aven, 2019): a proper risk characterization and risk assessment framework that addresses the aspects of uncertainty and (the strength of) knowledge supporting the judgment of risk is required to produce understandable risk messages for different stakeholders and contribute to better risk communication.
5) Policymakers should consider public perception and concerns as part of their decision-making: despite being intuitive and less formal than technical risk analysis, public risk perception is "much richer than that of experts and reflects legitimate concerns that are typically omitted from expert risk assessments" (Slovic, 1987, p. 282). Designing risk-based policies requires trade-offs between these concerns, not necessarily for measuring their potential impacts, but for providing value judgement in case of inevitable trade-offs in situations involving conflicting values or objectives (Aven, 2019).
6) Different strategies of stakeholders' engagement are required to account for the level of risk debates and the type of risk: when it comes to risk issues in energy infrastructures, the risk debate usually involves social and cultural values and lifestyles (the third level risk debate), and the risk type is highly complex, uncertain, and associated with high potential for ambiguity and controversy (Renn, 2008). Specific involvement strategies are required depending on the degree of expected stakeholder participation, in particular, the level of debate and the type of risk matter. In this regard, when the level of uncertainty is too high it is required to have a clear plan for managing uncertainty.
7) Timing of stakeholder engagement: for high-quality stakeholder involvement, it is vital to know who needs to know what and when. In the case of biogas plant siting, the involvement of affected neighbours and residents of Dalby was delayed, occurring after the completion of the main technical planning. Consequently, it was impossible to incorporate the concerns of the affected public into the process.
8) Scientific and technical solutions are not solely enough for the success of risk communication: such works, even when they are properly conducted may fail to gain the support of crucial stakeholders. This is particularly true for risk issues arising from a lack of proper understanding of the phenomena both scientifically and technically. Dissension in these matters is widespread, not only between different policymakers, scientists, and the public but even among the scientists and experts themselves (Rosa and Short, 2004). A combination of scientific and technical studies of stakeholders' expectations and concerns can support more effective risk handling.
9) Frequent dialogue between different stakeholders is required: risk communication is an ongoing process, not a one-time practice (Balog-way et al., 2020). In this way, societal dynamics, i.e., any changes in risk perception and concerns of different stakeholders, should be identified and reflected in the decision-

making process. Furthermore, a continuous dialogue between different actors and stakeholders as well as the public contributes to building trust.

10) The communicator's reliable knowledge and expertise about risk issues play a crucial role: the communicator should be able to discuss and respond to the stakeholders' concerns. Particularly for risk cases with high levels of uncertainty, the communicator should be knowledgeable enough about the risks and uncertainties, be able to address their concerns and provide a concrete plan for handling the uncertainties. In the biogas siting case, since the developer's representatives had difficulties in answering the public's questions, a negative impression formed that the developer lacked sufficient knowledge about the specific conditions of the chosen site.

7. Conclusion

Onshore wind farms are likely to play an increasing role in Norway's quest for sustainable and profitable renewable energy sources. They are receiving significant attention as part of the country's energy policy. Aligned with the principles of a democratic society, the Norwegian government is expressly committing itself to ensure that stakeholders' concerns about risk are heard and considered in the decision-making process. This approach has substantial implications for resource allocation strategies, the path, and the speed at which Norway aims to achieve its NetZero targets in 2050, ultimately shaping the nation's future energy landscape. Through a content analysis of high-level onshore wind energy policy documents and local/national news articles, this study points to specific needs, i.e., enhancing current risk communication practices, underscoring the importance of properly recognizing, involving, and establishing active communication strategies with affected residents. Our findings identify two main challenges: i) a lack of a comprehensive platform for assessing, managing, and efficiently communicating risk in current practices, and ii) a top-down risk communication approach that restricts the reflection of different stakeholders' concerns in decision- and policymaking. In response, some recommendations are provided by drawing on the knowledge from a risk science and risk communication perspective. An underlying idea is the importance of considering risk communication as a two-way practice to reduce the gap between experts'/professional judgment of risk and lay risk perception. To achieve this goal, broader perspectives on risk should be adopted by risk analysts and policymakers, ensuring that aspects of uncertainty and knowledge of the risks related to onshore wind farms are reflected in risk communication practices.

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