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Exploring the prospects for a shared vision of offshore wind energy at the national level

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ABSTRACT

Interest in developing offshore wind is rapidly increasing but remains in its early stages in many countries. This paper examines the role offshore wind could play in achieving Finland's 2035 carbon neutrality goal while identifying potential trade-offs with other marine uses. Based on results gathered from expert workshops and interviews, we present a co-created vision of offshore wind in 2035. Rather than presenting offshore wind as an inevitable solution, the results clarify the circumstances under which its development may be considered socially legitimate and environmentally acceptable. The vision reframes offshore wind as a bounded and contingent form of infrastructure development, shaped by environmental protection, governance stability, and expectations of regional and societal benefit. By making these trade-offs explicit, the study provides a structured basis for incorporating offshore wind into long-term energy and marine infrastructure planning without assuming its automatic desirability. The findings underscore the importance of integrating offshore wind within broader marine governance frameworks and long-term planning processes including marine spatial planning, regulatory design, skills development, and supporting infrastructure investment. The process revealed that participatory futures methods can help articulate trade-offs, foster dialogue, and share knowledge between expert stakeholders, with limitations related to participant composition and limited public engagement.

1. Introduction

Emissions from anthropogenic sources, particularly from the production of electricity and heat which account for 44% of global C02 emissions [1], are a leading cause of climate change. Climate impact models have shown that there is a need for immediate decarbonisation of our energy systems and a transition toward renewable energy to limit the increasing global temperature changes [2]. Offshore wind is a promising source of clean energy to aid in decarbonisation but remains in its early stages in many countries and has several challenges to overcome before it can be rapidly upscaled. Offshore wind turbines can impact both biodiversity and local communities [3,4] but creates regional economic growth and job development [5]. This is an example of a green-green dilemma, the challenge of producing clean, renewable energy while managing environmental and social impacts [6,7].

As land-based resources are becoming increasingly limited, the marine space is experiencing growing commercial interest from various industries, including offshore wind power [8]. Europe (including the UK) and China are leading in offshore wind development, with Europe responsible for around half of the global total installed capacity of 83 GW [9]. The European Union (EU) has set a goal to increase offshore wind power to 60 GW by 2030, and 300 GW by 2050, an increase from 16 GW currently in the EU−27 member states. The EU has a clear vision for ambitious offshore wind expansion, supported by rapid technological progress and decreasing costs [10,11].

Finland has set an ambitious goal to become carbon neutral by 2035, and wind power is expected to play a major role in achieving this [12]. Wind power is a relatively small part of Finland's energy mix accounting for approximately 14% of electricity production [13], but development is increasing rapidly. Interest in developing offshore wind is also increasing, and there are several projects underway (either in planning, permitting or construction phase) that are expected to rapidly increase the capacity of offshore wind over the coming decade [14]. Currently, there is one operational 73 MW offshore wind park on the west coast of Finland, and the state land authority has started tendering suitable marine areas that could further increase the capacity of offshore wind by

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6 GW [15]. Licensing and permitting for offshore wind currently involve multiple authorities across national and municipal levels, with different requirements in territorial waters versus the Exclusive Economic Zone (EEZ).

The aim of this study is to explore the role (if any) that offshore wind may play in the national energy mix in 2035 while making trade-offs associated with its development explicit. We sought to identify win-win solutions [16] to inform strategic, long-term planning. We brought together a diverse range of stakeholders to discuss and identify the solutions and issues that need to be addressed to ensure its sustainable development. We employed visioning and back-casting methods [17] allowing for the exploration of multiple or even conflicting future visions while identifying preconditions and concrete steps needed to achieve a desired sustainable future.

Despite a growing body of literature on offshore wind governance, spatial planning, and socio-environmental impacts, existing research has largely focused on present-day spatial conflicts [18,19], regulatory arrangements [20], cost and technological innovation [21–23] and stakeholder acceptance [24,25]. Comparatively limited attention is paid to how future-oriented, participatory methods can be used to understand long-term trade-offs in offshore wind development, particularly in the Baltic Sea.

This gap is particularly evident in Finland, where offshore wind is a promising, yet still emerging industry and long-term strategic direction remains in the planning phase [26]. Prior research has identified suitable locations for offshore wind in Finnish waters [5], and how EU regulation shapes national development [27], yet no official capacity targets or shared vision for offshore wind development have been established. In 2023, the Finnish Government announced that it "will set an ambitious target for offshore wind capacity in 2035" [26] but as of writing, no concrete targets have been set.

Visioning and back-casting have been used in other emerging energy technologies such as hydrogen [28,29], but remain underexplored in offshore wind research in the Baltic Sea. By applying and critically examining participatory visioning and back-casting through futures workshops, this study addresses this dual gap by examining whether these methods can surface competing values, make implicit trade-offs explicit, challenge dominant assumptions, and support more reflexive forms of decision-making in a contested socio-ecological context. In doing so, the paper contributes empirically by presenting expert-developed futures for offshore wind in Finland, and methodologically by assessing the strengths and limitations of futures-oriented participatory approaches for offshore wind governance. The goal is to be collaborative, emphasizing that the process of knowledge gathering is just as important as the results [30].

2. Method and data collection

We adopted a qualitative research design to explore preferred futures of the offshore wind industry. Data were gathered through two half-day futures workshops held in February 2023, followed by seven in-depth interviews conducted after the workshops; all interactions were carried out in English. Futures workshops are participatory sessions that bring diverse actors together to collaboratively explore, critique, and design preferred futures [31]. This approach was selected because it supports collective reflection on uncertainty, trade-offs and long-term planning, and is well suited to examining contested socio-technical transitions such as offshore wind development [31,32].

The study combined visioning and participatory back-casting. Visioning has become increasingly prominent in sustainability and planning research to support strategic reflection and long-term planning [19,33–36]. Back-casting, which develops pathways from a desired future back to the present, has been widely applied in energy and sustainability research [33,37,38]. Quist et al. [39] shows that participatory back-casting can support the articulation of shared future visions and the development of practical guidance for action among stakeholders.

Participants were selected using a purposive expert sampling strategy appropriate for an emerging industry in a small national context with a limited pool of participants [40,41]. Potential participants were identified through targeted desk-based searches of publicly available information, including organisational websites, policy documents, industry reports, and professional profiles, to ensure representation across key stakeholder groups. This approach aimed to capture informed perspectives from actors actively engaged in marine and energy related decision-making, planning, conservation or knowledge production. While the sample does not claim statistical representativeness, it reflects the breadth of expertise currently available within the Finnish offshore wind context.

Table 1 provides an overview of the number of participants in the workshops and interviews, and the stakeholder group they were representing. The registered participants were provided with preliminary material introducing the project and background, the objective, and goals for the workshop, prior visioning and strategic planning work relevant for energy issues and research results from earlier steps in this project, including a summary of drivers impacting offshore wind development [42] and weak signals and wild cards that could impact offshore wind development [43]. The appendices include the workshop format guide, interview guide, and preliminary material sent to the participants.

The two workshops were organised with the same structure but for two different groups of experts in different cities in Finland: Helsinki, in the capital area on the Gulf of Finland, and Turku, along the west coast in the Archipelago Sea. Both were organised in-person to facilitate free and open discussion and co-creation of ideas. The authors of this study acted in the role of workshop facilitators and began each workshop with introductory presentations on the practical details, current state of offshore wind and the theoretical background. Following these presentations, participants were divided into two groups based on their background, expertise and knowledge as assessed by the facilitators. Each group was assigned two facilitators for supporting and documenting the discussions. Participants first co-created four aspects of the vision individually in small groups, then reconvened to present summaries and reflect on each other's inputs. The second group task was to identify the concrete steps needed to reach the vision created in the first task. The participants co-created and discussed the required solutions needed to reach the vision and the responsible actors.

Following both workshops, we conducted seven semi-structured interviews to further broaden our understanding, strengthen the vision and include stakeholders that were not present in the workshops. Each interview lasted between thirty to sixty minutes virtually, most were recorded and later transcribed, or notes taken during the interview. The interview participants were provided with the same preliminary material, and further information outlining the general topics that would be raised during the interviews. The structure of the interviews followed closely the workshop structure; each participant was asked their opinion and insights into the four aspects of the vision (as noted above) and pathway steps for achieving their vision in 2035. They were then asked whether they agree with the vision statement developed in the workshops, whether they had any comments or suggestions and on which

Table 1
An overview of the participants in the workshops and interviews and the stakeholder group they were representing.

Stakeholder group	Number	Stakeholder group	Number
Workshops		Interviews	
Wind power association	1	Nature conservationist	1
Regional councillors	3	Recreational group association	2
Company representative	4	Company representative	1
Policy maker	3	State administration	1
Researchers	5	Grid operator	2
Total	16		7

points were important or could be modified. The interviews then concluded with any final comments or ideas on any topic the participants wished to raise.

The workshop and interview data were analysed using an iterative process using thematic analysis and comparative interpretation [44,45]. Notes, canvases and transcripts were reviewed across groups to identify recurring ideas, areas of convergence, and points of divergence. Common elements articulated independently by multiple groups were interpreted as indicative of shared priorities and were consolidated into a draft vision. This was shared with participants for additional comments and discussions, however, no further comments were received.

In a second analytical step, the actions and solutions identified during the workshops and interviews were compared and grouped into higher-level categories based on conceptual similarity and functional role. Through repeated comparison and iterative refinement between the authors, these categories were synthesised into a set of key preconditions and processes required to attain the vision, like other research in different contexts [46,47], reflecting the exploratory and futures-oriented nature of the study [32]. The aim was not to produce definitive explanations, but to develop contextual interpretations that emerge from the integration of workshop and interview outcomes and contextual expertise of the authors.

3. Results

This section presents findings from the participatory futures workshops and interviews. The results are organised around three elements: a shared vision, the preconditions necessary for its realisation, and the processes through which the transition from the present to the envisioned future may occur. These findings highlight both convergence and tension in expert perspectives and frame offshore wind as a conditional contributor to Finland's energy transition.

Analysis of the workshop discussions and follow-up interviews revealed that a set of common elements repeatedly emerged across discussions. Participants were explicitly encouraged to explore alternative, conflicting, or competing futures. Despite this, substantial convergence was observed around several core themes, which together formed the basis of a shared expert vision for offshore wind development in 2035.

At the core of this vision is the expectation that offshore wind will make a meaningful contribution to Finland's energy mix and climate mitigation efforts, and was consistently framed as acceptable only insofar as its negative environmental and social impacts are well understood and effectively mitigated. Biodiversity protection emerged as a particularly strong boundary condition, shaping views on both the scale and location of potential development. Compatibility with other marine uses, such as shipping, fisheries, recreation, defence, and nature conservation, was likewise treated as a fundamental requirement. Additionally, the vision emphasises the importance of regional and societal benefits including job growth, skill development and opportunities for community participation. Finally, development should be embedded within a broader, sustainable value chain and generate tangible benefits for regions and communities connected to offshore wind projects.

The consolidated vision statement below represents an analytical synthesis of these recurring elements across workshops and interviews. It is not a verbatim participant statement, but a condensation of shared positions articulated by diverse expert stakeholders:

> *"Offshore wind will become an important part of Finland's energy mix and contribute to achieving climate and biodiversity targets. The negative environmental and social impacts of installations will be fully understood and mitigated, and the most suitable locations are chosen. Offshore wind will create sustainable value chain opportunities where some resulting benefits remain in the region, and it can be freely chosen by consumers and organizations if it meets their needs."*

While this vision does not imply full agreement on all aspects of offshore wind development, it reflects areas of alignment across diverse expert perspectives regarding the conditions under which offshore wind is considered desirable, legitimate, and sustainable. Importantly, this future was rarely described as inevitable but framed as contingent on specific governance, environmental, and socio-economic conditions being met.

Building on the shared vision, the analysis identifies five preconditions that stakeholders consistently framed as necessary for the vision to be realised by 2035. These preconditions emerged across stakeholder groups and data sources and were repeatedly invoked in discussions of feasibility, legitimacy, and long-term sustainability. Together, they delineate the boundaries within which offshore wind development is considered acceptable and viable. These elements are synthesised in Fig. 1, which illustrates the relationships between the vision, its preconditions, and the processes identified.

The first precondition concerns the management of negative externalities across the full lifecycle of offshore wind projects, including development, operation and decommissioning, so that negative externalities are reduced to a level at which positive externalities outweigh them. Biodiversity protection was repeatedly framed as setting hard limits on offshore wind development, with designated conservation areas effectively constraining both scale and siting decisions. Environmental impact assessments were described as a critical governance instrument for defining acceptable thresholds of impact and mediating trade-offs between climate mitigation objectives and biodiversity protection. Minimising conflicts with other marine uses was likewise treated as integral to the legitimacy of offshore wind development.

The second pre-condition concerns the availability of a highly educated and skilled workforce capable of addressing the technical, environmental, and social challenges, particularly in the relatively challenging Finnish environment. The analysis highlights a perceived skills gap in areas such as cold-climate engineering, marine ecology, spatial planning, and stakeholder engagement. This gap was framed as a constraint not only on project implementation, but also on the ability to assess impacts and ensure a just energy transition that adequately addresses social concerns such as noise, visual impacts, and conflicts over marine space.

Governance clarity and stability emerged as a third precondition shaping the feasibility of offshore wind development. National policies on marine spatial planning, nature protection, and municipal zoning were identified as key determinants of where and how offshore wind can be developed. Uncertainty in permitting and licensing processes, particularly across territorial waters and the Exclusive Economic Zone (EEZ), was consistently framed as increasing risk for developers and undermining long-term planning and coordination. A stable regulatory environment was therefore viewed as essential for aligning environmental protection, investment, and societal acceptance.

The fourth pre-condition relates to the development of a sustainable value chain as a necessary condition for offshore wind to deliver benefits beyond electricity generation alone. This includes manufacturing, logistics, ports, vessels, maintenance services, and decommissioning activities. Stakeholders emphasized that local and regional participation in the value chain is critical for ensuring social acceptance and for linking offshore wind development to broader regional development objectives.

The final pre-condition emphasises that offshore wind should be one component of a broader, diversified, and resilient energy system rather than as a singular solution. The analysis highlights support for a technologically neutral approach, allowing different energy technologies to develop based on economic viability, environmental performance, and social acceptability. Offshore wind's future role was therefore evaluated in relation to system-level considerations such as grid capacity, energy security, and flexibility.

While the preconditions define the boundaries for a desirable offshore wind future, the analysis also identifies five key processes through which these conditions could be actively created over time. These processes represent thematically grouped pathways articulated

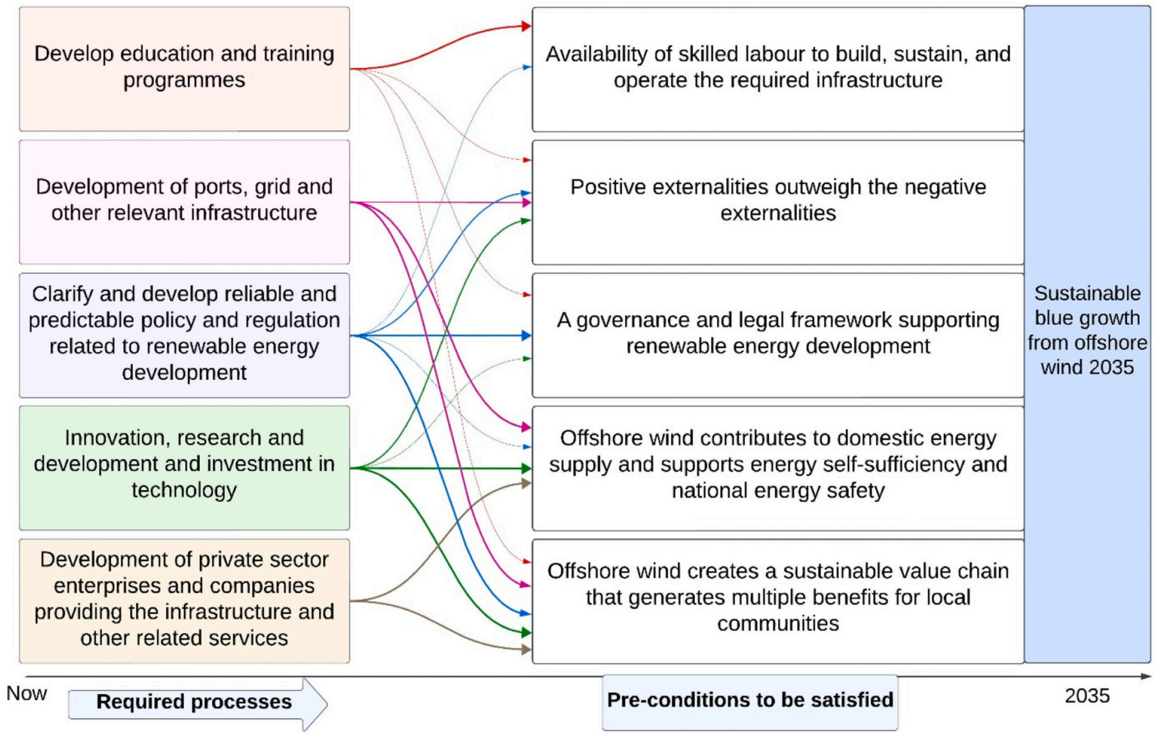

Fig. 1. A visual representation of the vision of offshore wind in the year 2035. The first column are the processes to transition from today's state to meet the pre-conditions and the 2035 vision. The second column are the preconditions that must be satisfied if the vision is to come to fruition in 2035. The connecting lines represent the relevant interactions between the processes and pre-conditions where the thicker line represents a higher relevancy.

across the qualitative data and reflect stakeholders' views on how the transition from the current state toward the 2035 vision might be attained.

Table 2 below presents the solutions identified by participants, and highlights information on the decision makers, implementors, solutions and beneficiaries for each of the five processes. The scope has been narrowed to represent actors directly responsible or affected. The solutions and processes may overlap, and this exercise is not about strict categorisation but an overall understanding of the potential solutions.

The first process highlights investment in education and training as a foundational process for enabling offshore wind development. Addressing the perceived skills gap was framed as essential for project implementation, impact assessment, and the long-term legitimacy of offshore wind. Universities, vocational institutions, and industry actors were identified as primary implementers, with national and municipal governments playing an enabling role through funding, policy support, and immigration frameworks for attracting international expertise.

A second process concerns the development of clear, predictable, and coordinated policy and regulatory frameworks. Regulatory uncertainty, especially differences between territorial waters and the EEZ, was highlighted as a major barrier to strategic planning and investment. Regulatory clarity is viewed not only as a means of reducing risk for developers, but also as a mechanism for enhancing transparency and public trust in decision-making.

The third process relates to ongoing innovation and investment in offshore wind technologies and supporting infrastructure. Offshore wind was widely regarded as becoming increasingly cost-competitive, the Finnish context was described as presenting persistent technical uncertainties, particularly related to ice conditions and grid integration. Participants highlighted a need for dynamic and iterative innovation requiring sustained collaboration between industry, research institutions, and public funding bodies.

The fourth process requires the development of private-sector enterprises and services for ensuring that offshore wind generates broader economic benefits. Flexible and anticipatory planning practices were emphasised as necessary to accommodate technological change and market uncertainty. Value-chain development was closely linked to discussions of social acceptance and regional development, particularly for coastal communities directly affected by offshore wind projects. Participants consistently described the development of a sustainable offshore wind value chain as a critical process for ensuring that economic benefits extend beyond energy production alone.

The final process concerns the coordinated planning and development of ports, transmission grids, vessels, and other supporting infrastructure. The analysis highlights the importance of holistic marine spatial planning informed by scientific evidence and local knowledge, particularly given competing uses of limited marine space. Infrastructure development was consistently linked to transparency, participation, and long-term planning capacity, and in some cases to cross-border coordination.

Across workshops and interviews, stakeholders also articulated a range of challenges related to governance, investment, and social legitimacy that may complicate the transition toward the 2035 vision. These challenges are interpreted and examined in more detail in the discussion section.

4. Discussion

Offshore wind is one industry with great potential but there lacks a clear understanding on its role in meeting Finland's 2035 carbon neutrality goal. This paper presents an expert-developed vision for the offshore wind industry in Finland, identifies five preconditions that must be met for this vision to be realised, and outlines five interrelated processes required to support the transition. The following discussion elaborates on two key outcomes arising from this process: first, the emergence of a shared vision across diverse expert perspectives, and second, the explicit identification and collective exploration of "green–green" trade-offs between climate mitigation and marine

Table 2
information on the decision makers, implementors, solutions and beneficiaries for each of the five processes required to transition from today to the vision.

Process	Decision makers	Implementors	Solutions	Beneficiaries
Develop education and training programmes	Universities, schools, national governments	Universities, Vocational schools, industry, and municipal councils	Plan and identify new research and education hubs for offshore development and site identification Allocate resources for development and implementation of training and educational programmes Clarify the legislative and procedural processes for international workers to obtain visas	Students, industry, local communities
Clarify and develop reliable and predictable policy and regulation related to renewable energy	National and municipal policy makers	Ministries, governmental and public sector organizations	Clarify and develop reliable and predictable rules for permitting and licensing for infrastructure development Identify and auction the most suitable areas for infrastructure development Harmonise legislation (including property taxation) across the territorial waters and EEZ for offshore wind development and operation	Energy industry, consumers
Innovation, research and development, and investment in technology	Industry, policy makers (global, regional, and national)	Industry, research institutions	Develop a clear plan for technological innovation, research and investment needed to bridge the uncertainty Continuously monitor and learn from other countries developing offshore wind technology	Industry, society
Development of private sector enterprises and companies providing the infrastructure and other related services	Industry, investors	Industry, local communities	Continuous identification and mapping of niche opportunities for small businesses connected to the value chain Adopt flexible planning strategies Continuous foresight to anticipate changes, new events, and surprises in the value chain	Industry, local communities, society
Planning and development of ports, grid, and other relevant infrastructure	National and municipal policy makers, civil society actors	Industry, municipal and national governments	Develop a national roadmap and vision for holistic marine development (including the EEZ), including the development of offshore wind Infrastructure is planned and developed holistically and transparently after evaluation of cumulative impacts Develop detailed marine spatial plans with extensive stakeholder and industry participation with scientific evidence and local knowledge Whole sea areas (including EEZ) to be mapped	Marine industry, coastal communities

biodiversity protection.

The first outcome arising from the process is that diverse expert stakeholders, despite varying expertise, articulated a coherent shared vision rather than conflicting or opposing ideas. This outcome provides an important empirical evaluation of the capacity of visioning and back-casting approaches to reveal both convergence and divergence in expert opinions. Rather than amplifying fragmentation, the futures workshops enabled participants to articulate shared priorities while acknowledging underlying trade-offs. Visioning and participatory research facilitates structured dialogue across disciplinary and institutional boundaries, aligning expert perspectives, making implicit assumptions and competing sustainability objectives explicit, and generating actionable insights through shared learning between experts [48,49]. These findings illustrate how futures-oriented participatory methods can function not only as exploratory tools, but also as integrative spaces that support long-term decision-making in complex "green–green" dilemmas in offshore wind governance.

However, an important consideration when reflecting on this is understanding the composition of participants in the workshops and the presentation of the preliminary results to the interviewees. The results represent expert opinions and viewpoints of well-informed professionals, which may differ from the opinions of the public or communities close to offshore wind parks. Understanding critical issues relevant for local communities is key to ensuring sustainable development and finding win-win solutions [50,51]. Thus, a next step in this research could expand the scope to include wider public engagement such as surveys, local community workshops or focus groups, to explore how local communities and those directly impacted by offshore wind development perceive the future of the industry and the marine space more broadly.

The second outcome arising from the process concerns the explicit trade-offs identified and explored by experts between the contribution of offshore wind to climate change mitigation targets, and its potential impact on surrounding biodiversity and marine ecosystems. Offshore wind energy aids in reducing greenhouse gas emissions, provides clean energy, and creates employment and economic opportunities; however, its development, operation, and dismantling can have negative impacts on surrounding ecosystems and biodiversity [3]. Strict biodiversity protection may necessitate a rejection of many renewable energy projects, including offshore wind, creating a clear "green–green" dilemma in which competing sustainability objectives benefit different stakeholder groups [52].

Importantly, this tension emerged not simply as a substantive finding but also as an outcome of the futures-oriented methodological approach itself. Through the futures workshop process, these trade-offs were not only acknowledged but collectively explored, as bringing diverse expert and stakeholder perspectives into a shared space enabled participants to articulate underlying values, assumptions, and priorities that are often treated separately in sectoral debates. Jouffray et al. [8] highlights the importance of dialogue and value awareness in navigating complex sustainability trade-offs, and we found that the added value of participatory futures methods aids in making such trade-offs explicit and supporting shared learning through expert discussions.

The analysis of the data suggests three governance and coordination challenges faced by public authorities, planners and other key institutional actors in transitioning towards the shared vision. Firstly, a supportive political environment, including a streamlined and clear permitting and licensing process, can have substantially positive impacts on the development of renewable energy and ensuring public trust in infrastructure development [20,21,53,54]. In addition, effective policy frameworks are required to support the development of domestic offshore wind value chains and investments in human capital [55]. International experience illustrates how coordinated legislative and administrative arrangements, such as one-stop-shop permitting systems or long-term policy support for renewable energy, can facilitate investment, innovation and technological development, as demonstrated in countries such as Denmark and the United Kingdom [56].

In the Finnish context, these challenges are particularly visible in the regulatory arrangements governing offshore wind in the exclusive economic zone and territorial waters, where rules have historically differed and lacked clarity. Since the completion of the empirical data collection for this study, the Finnish Government has announced planned measures aimed at clarifying and streamlining licensing and permitting procedures and improving coordination across Finnish marine areas [26]. While the concrete implementation and impacts of these measures remain to be seen, this policy development shows how national regulatory environments are evolving in response to emerging offshore wind ambitions. This illustrates a more general challenge for offshore wind development: when regulatory reform and administrative capacity lag behind industrial and investment interest, uncertainty can delay project pipelines. While recent policy initiatives signal an improving regulatory environment, the timing and pace of policy implementation remain critical factors shaping the ability of offshore wind to contribute to wider energy and industrial transition objectives.

The second category of challenges concerns distinguishing between public and private investments in offshore wind and related infrastructure and determining how to achieve a fair balance between these funding sources. Offshore wind projects are highly capital-intensive, where up to 75% of the lifetime costs are upfront [57] and there is uncertainty and risk in how the technology will develop [58]. An understanding of the long-term commitment and share of public investment in the required infrastructure (grids, ports, transportation networks) and institutions (education, labour) is important to reduce uncertainty and provide the private sector with an expectation on the required investments needed to upscale the technology.

The third category of challenges relates to the communication and engagement processes surrounding offshore wind development. Public perceptions are shaped by multiple, context-specific factors, including whether development is seen to create opportunities for local communities, whether it is perceived to be compatible with environmental protection objectives, and how potential impacts on ecosystems and local livelihoods are addressed and mitigated. In addition, public debate may be influenced by ad-hoc and rapidly evolving information environments, including social media, which can amplify both accurate and misleading information [43].

Rather than reflecting a general lack of public support for offshore wind, this challenge concerns the capacity of institutions, developers and public authorities to ensure transparent, timely and inclusive communication, effective exchange of scientific knowledge, and open channels for dialogue throughout planning and development processes. Meaningful engagement of stakeholders and citizens, and institutional mechanisms for responding to concerns, have been identified as important conditions for just and inclusive offshore wind development [50,59,60]. The European Parliament has likewise emphasised the need to strengthen public participation and communication in offshore wind planning within EU member states [10]. This challenge is inherently site- and region-specific and depends on the design and resourcing of local and national engagement processes.

4.1. Considerations and further research

Several scholars have criticised the visioning method for lacking a sound theoretical base and questioned whether visioning can promote action [61,62]. Additionally, examples have been raised where the vision has failed on guiding transformational change [63]. On the other hand, other studies report that participatory visioning exercises have been gaining relevance in sustainability and energy transition research and are one tool for promoting transformative changes [35].

Although a consensus vision emerged, it reflects the perspectives of expert participants, and our results cannot be generalized as a broader national vision due to the limited scope we chose. The selection of participants influences which values, assumptions, and forms of knowledge are represented in the visioning process. In addition, presenting the preliminary results to interviewees in full-sentence narratives may have constrained opportunities for critique or reframing, particularly for participants working in a non-native language. However, we presented these sentences to the interviewees after they shared their initial ideas for a vision of offshore wind. Together, these factors may have favoured convergence around shared expert perspectives, potentially limiting the expression of more divergent or critical viewpoints [64,65]. Inclusion of local communities could reveal alternative priorities for infrastructure development, marine spatial planning or environmental trade-offs. Future research could address these limitations by engaging a wider range of stakeholder groups, deliberately exploring multiple or competing visions to capture a broader spectrum of perspectives and avoid over-representing dominant policy or industry narratives.

5. Conclusion

This study examined the prospective role of offshore wind in Finland's energy system by 2035 through participatory visioning and backcasting methods. The main finding positions offshore wind as a conditional contributor to Finland's carbon neutrality ambitions, dependent on a set of five preconditions and enabling processes spanning governance, infrastructure, skills, innovation, and value chain development. Rather than presenting offshore wind as an inevitable solution, the results clarify the circumstances under which its development may be considered socially legitimate and environmentally acceptable.

We found that a shared vision amongst well-informed expert stakeholders for offshore wind can emerge even within a contested "green–-green" dilemma, where climate policy targets intersect with biodiversity protection and competing use of marine space. This vision reframes offshore wind as a bounded and contingent form of infrastructure development, shaped by environmental protection, governance stability, and expectations of regional and societal benefit. By making these conditions explicit, the study provides a structured basis for incorporating offshore wind into long-term energy and marine infrastructure planning without assuming its automatic desirability.

From a policy perspective, the findings underscore the importance of integrating offshore wind development within broader marine governance frameworks and long-term planning processes. The articulation of preconditions and transition processes offers a practical framework for aligning offshore wind development with marine spatial planning, regulatory design, skills development, and supporting infrastructure investment.

CRediT authorship contribution statement

Maria Malho: Methodology, Conceptualization. **Kilpo Jenni:** Methodology. **Kari Hyytiäinen:** Writing – review & editing, Supervision, Methodology, Formal analysis, Conceptualization. **Jamie Jenkins:** Writing – review & editing, Writing – original draft, Visualization, Methodology, Formal analysis, Data curation.

Declaration of Competing Interest

None.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.marpol.2026.107261.

Data availability

Data will be made available on request.

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