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Trust, fairness, and transparency: Perceptions of energy justice in Maine's offshore wind planning process

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ABSTRACT

Recent advances in technology have expanded the focus of U.S. offshore wind beyond near-shore development to deeper waters including the Gulf of Maine, necessitating floating wind technology. The larger spatial footprint and associated mooring lines create a unique conflict for fishermen. In addition to potential exclusion zones, there are also localized concerns including a lack of direct community benefits, local workforce impacts, and equitable distribution of benefits and costs. There remains a considerable opportunity to better understand the complex analyses that drive acceptance, such as the distribution of benefits and burdens, risk perception, the role of institutions, and perceptions of fairness in decision-making. Dynamic, multisensory visualizations using virtual reality (VR) offers a progressive approach to stakeholder engagement with fishing communities. We present results from an attitudinal study in coastal Maine's fishing communities facing floating offshore wind proposals, where tensions between fishermen and wind development were high. Using interviews with immersive VR where participants interacted with a modeled wind farm in Maine, we find elements of distributive justice were prevalent, and that impacts to the "fishing community" were stronger drivers of perceived burdens than personal effects were. We also find that elements of procedural justice (information access, trust in decision-makers, and transparency) were as or more important drivers of perceived fairness in offshore wind decision-making than issues of distribution of benefits and burdens. Our findings underscore the importance of local context, partnerships with local institutions, and enhanced information access to facilitate more collaborative decision-making and improve goodwill among all parties.

1. Introduction

Offshore wind energy (OSW) is a clean energy source with tremendous technological potential, located near some of the largest load centers in the United States (U.S.) [1]. State and federal policies from prior federal administrations encouraging OSW as a solution to meet clean energy targets have set in motion significant interest in developing OSW in the Northeast U.S. Recent advances in floating offshore wind technology have expanded focus beyond near-shore development into deeper waters which now include the Gulf of Maine and California and the Pacific coast, as well as farther offshore in the Northeast and the Mid-Atlantic. Once considered cost-prohibitive and technologically nascent, floating wind farms such as Hywind Tampen off Scotland, and Windfloat Atlantic off Portugal have been successfully deployed in Europe. Floating wind is now an emerging market in the U.S. [2].

Offshore wind proposals in the U.S. have been fraught with uncertainty, stakeholder conflicts, and in some cases, powerful local opposition. Although offshore wind may contribute significantly to the U.S. energy transition, development has been stymied by opposition from ocean users [3] and is partly limited by social factors [4]. Ocean users, mainly fishermen, have raised alarm over space use conflicts that may arise from the development of offshore wind projects. Floating offshore wind differs from fixed-bottom turbines, potentially generating different ocean use impacts: the spatial footprint is larger, arising from the spread mooring system for each floating wind turbine unit, and the suspended cables and mooring systems may generate unique hazards to ocean users such as commercial fishers.

Impacts on marine resource-dependent coastal communities from OSW development have been a source of recent scholarship in the energy social sciences and have garnered significant media attention, particularly in areas facing turbine construction activity [5]. The Gulf of Maine is a region in the Northeast U.S. that has intermittently been

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under intense scrutiny as wind energy projects have been proposed. The State of Maine Governor's Energy Office (GEO) proposed a 144-MW floating wind demonstration project and began contract negotiations with the state utilities commission in 2021, and was awarded a lease to 15.2 mi^2 in the Gulf of Maine for the "research array" [6]. At the time of the research, the lease had not yet been issued, but the project planning was well underway, and state and federal agencies were hosting frequent public meetings throughout the state. In addition, the federal leasing agency, the Bureau of Ocean Energy Management (BOEM), had also issued public notices about planning processes to lease commercial-scale offshore wind in the Gulf of Maine and had identified several million acres of area that were under consideration. Ultimately, a much smaller area was planned for leasing to private developers, although the public engagement work was intended to iteratively remove areas from a large region.

State and Federal agencies faced strong responses from fishing communities across the State of Maine and the New England region. BOEM held a series of in-person public meetings targeted for the fishing community across the Gulf of Maine. Fishing communities were vocal about offshore wind: in recent years, Maine fishermen had initiated anti-wind legislation (LD 101 (HP 67), An Act To Prohibit Offshore Wind Energy Development), held boat processions with anti-wind messaging such as "Save the Lobstermen, Stop the Mills" [7], launched public media campaigns and started advocacy groups demanding accountability and transparency in siting and permitting processes, scientific research, and greater voice in decision-making.

Coastal community members have strong ties to marine-dependent employment in Maine. Lobstering supports thousands of jobs and is nearly a billion-dollar industry with low economic and social resilience [8]. Lobstering also has strong ties to tourism, supports multi-generation family heritage, and offers opportunity in resource-limited, rural and island communities. In this study, we target fishing-dependent communities in Maine to study perceptions of floating offshore wind. Fishing communities are defined in the U.S. as "substantially dependent on or substantially engaged in the harvest or processing of fishery resources to meet social and economic needs, and includes fishing vessel owners, operators, and crew and United States fish processors that are based in such community" (16 USC § 1802(17)). We implemented an immersive multisensory virtual reality environment as an attitudinal elicitation tool for people in fishing-dependent communities facing proposed floating offshore wind projects, due to the relative unfamiliarity of floating wind technology among the public. The study's aim is to advance the understanding of complex factors that drive the nuanced and contested narratives that underlie support for and opposition to floating wind energy, and to more broadly understand perceptions of justice among fishing-dependent communities.

To that end, we pose the following research questions:

1. What are the perceptions, attitudes, and underlying values towards floating offshore wind in the Gulf of Maine in fishing-dependent communities?
2. Are the benefits and burdens of floating wind in the Gulf of Maine perceived to be fairly distributed?
3. Is the planning and decision-making process in the Gulf of Maine trusted, and perceived as fair?

2. Theory

Social responses to wind energy are highly variable, context-dependent, and often place-based. Most research on social responses towards offshore wind has centered on more mature, fixed-bottom technology, which has dominated the global offshore wind market for the past several decades. While much has been written about support for and opposition to wind energy, there remains considerable opportunity to understand the complex analyses that drive acceptance, such as place-based benefits and impacts, risk perceptions, the role of institutions and

governance, and justice and equity aspects to renewables [9]. Much less is known about the underlying beliefs, perceptions and concerns of coastal communities who may be impacted by the nascent floating offshore wind industry, and whether acceptance of floating wind is different from acceptance of fixed-bottom wind technology. Offshore wind planning and permitting processes are different from land-based processes, which provides the basis of much of the public perceptions literature. While onshore wind typically requires large tracts of land agreements to be formed with private landowners [10], offshore wind in the U.S. is developed on public submerged lands, conflicting with common-pool resources. The public has much less familiarity with offshore wind than with onshore wind, and evolving governance processes for offshore wind have led to a lack of clarity for offshore wind development [11]. Despite these differences, researchers have highlighted the importance of learning from the onshore wind experience [12].

A well-known phenomenon in wind energy social science literature is the "social gap," where society has high levels of support for renewable energy in general, but few projects are actually achieved [13]. Similarly, the 'individual gap' instructs that a person sometimes has positive attitudes towards wind energy but opposes local developments when proposed [13]. Scholars have offered a myriad of explanations to describe the negative responses towards local wind energy proposals - both physical attributes as well as socially constructed attributes. Physical attributes of wind turbines or wind farms themselves that are frequently researched include responses to sound, aesthetics, property values, size and scale, and land use changes, among others [14].

People who have limited experience with an offshore wind farm may have a difficult time conceptualizing accurate physical attributes [15]. Virtual reality (VR) environments are increasingly used to represent operational conditions for proposed industrial designs, moving from the hypothetical to visualized opportunities for dialogue. Immersive VR can correct many of the misconceptions about wind farms [15,16]. Cranmer et al. [15] observed that a short VR experience changed participants' acoustic and visual perceptions of wind energy projects by realigning their preconceived ideas about turbines with a spatially and acoustically accurate representation. Similar studies suggest that participants who are provided an immersive VR experience of a proposed wind energy environment report 1) feeling more informed and less uncertain than participants who were shown only a static picture of the proposed wind energy site [17]; and 2) initial perceptions about the visual impacts of offshore wind farms were updated when the virtual wind turbines were shown from different distances from the shore [18]. Cranmer et al. [19] found that immersion and consistency with the real world were the most effective forms of visualization for clearly conveying abstract information about wind energy projects.

In addition to physical attributes of wind farms, socially constructed attributes are concepts created or defined by society; examples include the concept of place-technology fit [20], industrialization of the ocean [21], trust in decision-makers and fairness in decision-making processes [22]. Acceptance of new technology is sometimes characterized through what is known as the "triangle" of acceptance [23]: socio-political, market, and community acceptance. Socio-political acceptance is broadly conceptualized as acceptance of policies and technologies [23]. A key aspect of socio-political acceptance is trust in institutions, which is essentially whether people believe that key actors have "public-serving motives" [24]. This includes public trust in the government, the energy sector, and research. Trust in government is associated with attitudes towards offshore wind development. At the Block Island Wind Farm, the first offshore wind development in the U.S., Firestone and others [25] found that trust in state government led to beliefs about fairness in decision-making processes, which was the most important attribute driving support of the wind farm.

Perceptions of fairness in decision-making include trust in government, but also modes of engagement and whether the distribution of benefits and burdens is equitable. A growing body of literature shows

that attitudes and local project support are influenced by perceptions of the decision-making process for wind energy projects. Acceptance of wind energy projects is widely correlated with perceptions of a fair planning process [26]. For example, people who live near wind projects and who feel they have been given an opportunity to provide substantive input into decision-making are more likely to have positive attitudes towards the project, and perception of transparency from the energy developer was even more important in driving attitudes [27].

Public participation in U.S. energy planning is often top-down, where government entities sometimes engage in one-way communication where substantive input is not available to stakeholders [28]; requirements are established for public consultation, but this does not guarantee that members of the public can engage in a substantive way or that public comment is incorporated into policymaking [29]. Community engagement and public decision-making can fall along a spectrum, starting with performative consultation where the public has limited or no influence, to empowerment where the community is the decision-maker [30]. Nilson et al. [10] find that developers of large-scale renewables tend to favor public engagement that amounts to tokenism: the public is able to provide input, but not share in decision-making.

Fair process is one aspect of energy justice. Energy justice is a normative framework that is often offered as a moral imperative to do right by people. It can also be used in programs, decision-making processes, or policy evaluation, where various attributes are examined by whether or not they meet the standards of justice as commonly described in a three-tenet model: distributive, procedural, and recognition justice [31]. Studies of the energy transition call for greater examination of procedural and distributive justice specifically [32], although other researchers specify that justice tenets are not mutually exclusive as perceived by community members [33].

Distributive justice accounts for fair distribution of the benefits and burdens of energy development. Distributive justice acknowledges that the costs of clean or fossil energy may be (and often are) disproportionality spread in certain communities, due to factors such as geographic proximity, marginalization and lack of political leverage, or lack of access to benefits such as local jobs [29]. Offshore wind projects in coastal and fishing communities generate community-related concerns, including a lack of local benefits, workforce impacts, equitable distribution of benefits and costs, and spatial use conflict [34]. Spatial use conflict may limit fishing operations at current or historical commercial fishing grounds [3,35,36]. Fishermen may face distributional injustice from lost fishing grounds [3,37]; distributional effects can extend onshore [38]. Various forms of compensation have been proposed as a way to mitigate lost access to historic fishing grounds [39,40]. Distributional effects also apply beyond economic costs for fishermen; as fishing entails much more than financial compensation and fishermen have attachment and well-being associated with their occupation [41]. Offshore wind may thus impact the cultural aspects of fishing communities as their traditional way of life is threatened [35,42].

Procedural justice considers whether there is fair treatment of stakeholders and fairness in decision-making [43]; perceived fairness of the development process of offshore wind is frequently associated with public attitudes [22]. Dwyer & Bidwell report that formal public engagement processes often fail to meet stakeholder expectations towards offshore wind managers and developers, which in turn creates a lack of trust in decision-making [44]. Both structural (rules and regulations) and implementational (processes initiated by the developer) factors can lead to procedural injustices because of the limited opportunities for substantive input in wind farm planning [10,45]: for example, practical actions such as how public meetings are held, and how feedback is incorporated, shape whether justice goals are met [10]. Past offshore wind proposals in fishing communities demonstrate that implementation of public consultation has been viewed as performative: fishermen describe consultation as a box-checking exercise [46]. Other studies corroborate this: in the U.S., fishermen engaged in early offshore wind proposals wanted a seat at the table, but they viewed their role as

passive, relegated to providing information, and lacking empowerment in decision-making [47]. Smythe et al. note that box-checking engagement fails to give communities real influence, and that opaque permitting processes undermine trust [33].

In this study, we examine the contested narratives among government-sponsored OSW initiatives and the affected fishing-dependent communities in the Gulf of Maine. We identify ways that community members view the planning and decision-making process through a procedural and distributive justice lens. We also examine how prior history with governmental organizations is associated with perceptions of process, and how trust in institutions impacts perceptions of fairness and transparency in decision-making. Finally, we thematically characterize how impacts are perceived at varying scales, particularly concerning the distribution of benefits and burdens among individuals, communities, and the region. Our innovative approach offers insights about the tensions in OSW planning in fishing-dependent communities in Maine and beyond.

3. Methods

We developed a multi-stage mixed method attitudinal study in two fishing-dependent communities in coastal Maine. We used qualitative methods to elicit attitudes and perceptions of floating wind through in-depth interviews analyzed using thematic analysis, supported by a multisensory virtual environment for users to interact with an offshore wind farm in a realistic and immersive way. Participants were members of two fishing-dependent communities in coastal Maine, recruited through partnerships with state, local, NGO, and fishing industry partners.

3.1. Site selection & local context

Target communities and participants were selected based on a stakeholder asset mapping workshop with our expert advisory committee, which included members of NGO, state, and fishing industry partners. The workshop was convened for the purposes of this study. Two fishing communities were ultimately chosen for data collection where dependence on marine resources is culturally and economically significant: Harpswell, Maine and Boothbay Harbor, Maine - both small communities of ~5000 residents. Harpswell (Town 1) is a coastal community comprised of several decentralized villages and has a long-standing fishing industry, including lobstering and other commercially valuable species. Boothbay Harbor (Town 2) is a small town that hosts a vibrant summer tourist economy and has a commercial fishing pier dominated by lobster fishing. At the time of data collection, community members in Boothbay Harbor were in discussion with an offshore wind developer on a different project regarding a $1 M community benefits package to offset localized impacts from offshore wind transmission [48].

The research team familiarized themselves with governmental public engagement efforts in Maine by attending various public meetings hosted by state and federal agencies from 2019 to 2024. Each meeting was open to the public, with agenda items ranging from large inter-agency meetings to start energy siting processes to targeted, smaller fisheries-specific meetings to address specific concerns. These were attended by a mix of members of the fishing community, energy industry representatives, NGOs, and other interested members of the public. The research team also spoke with stakeholders and governmental actors about their perceptions of both the engagement process and the decisions that were made. This afforded the team the opportunity to better understand the complex dynamics between decision-makers and stakeholders.

3.2. Participant recruitment

Outreach occurred in each community using several approaches.

First, participants were identified through stakeholder asset mapping with our expert advisory committee. Asset mapping is a participatory process to document the resources in a community, prioritizing opportunities that build on existing strengths and place-based resources [49]. The asset mapping process included the following steps: 1) identification of participants; 2) facilitation plan; 3) brainstorm resources, and 4) develop an outreach and engagement plan [50]. Participants identified included people who were involved in local government or decision-making, fishing or the seafood economy, members of working waterfront industry groups, or other local community leaders. Individuals were contacted via email and phone, and we used snowball sampling to identify additional respondents.

Over several years, the research team conducted participant observation and built partnerships with local networks in each community. We then collaborated with three local libraries to support data collection over several weeks in each town. Participants were recruited using local networks and by distributing recruitment materials at public locations, including working piers, businesses, and community gathering spots. Recruitment also occurred through informal networks via social media and dockside conversations, where trusted members of the working waterfront and fishing community endorsed the research team. Trust-building was imperative to achieve data collection because of the contested nature of OSW in both communities. A total of 37 respondents were interviewed (21 in Harpswell and 16 in Boothbay); 14 were members of the commercial fishing industry or associated maritime trades, 9 were recreational boating enthusiasts who use the ocean very frequently, and 14 were members of the public who lived at the coast but were infrequent ocean users. See Table 1. We refer to respondents in the results by interview number and by characterization of ocean use: CF = commercial fishermen or ocean occupation; FR = frequent ocean recreationists, IR = infrequent ocean recreationists. Interviewees were provided a modest incentive to compensate for time spent in the interview.

3.3. Data collection: Interviews with virtual reality

3.3.1. Immersive environment development

Immersive VR has been found to address misconceptions and update respondents' visual and spatial perceptions of wind farms [15,16,19]. The VR environment was developed according to technical specifications of the 15-MW IEA Reference turbine. We designed the turbines [51] built on a floating, semi-submersible platform [52], which included spinning turbines that move with metocean conditions, lighting, blade and ocean sound, and spatial reference points (fishing vessel, data

Table 1
Interviewee characteristics in fishing-dependent communities in Maine, $n = 37$.

	Town 1	Town 2	Occupations
Commercial fishermen and ocean occupation $n = 14$			
Age range	32–68	22–78	Commercial fisherman, Military Veteran, Boatyard Manager, Marine transport operator
Respondents	7	7	
Gender	6 male,1 female	7 male	
Frequent ocean recreationists $n = 9$			
Age range	42–80	21–71	Artist, Engineer, Teacher, Safety officer, Housekeeper, Scientist, Insurance agent.
Respondents	5	4	
Gender	3 male, 2 female	2 male, 2 female	
Infrequent ocean recreationists n = 14			
Age range	36–68	45–76	Town or state employee, NGO management, Health provider, Scientist, Construction/ Landscaping, Designer.
Respondents	9	5	
Gender	2 male, 7 female	2 male, 3 female	

buoy). We developed and rendered a 360 panoramic field of view to allow for a more immersive experience. See Appendix A for technical specifications of the VR environment.

3.3.2. Interview procedure

Respondents opted-in to the study and were individually scheduled for a 1-h interview at one of the local public libraries in each community. The interview protocol was designed around three major sections and was conducted by two researchers: one to conduct the interview, and one to run the VR simulation. The interview protocol and VR environment were iteratively developed and pilot-tested over 18 months before data collection, see Appendix B for the interview protocol. The study was approved for ethics in human subjects research.

The interviews opened with introductory context-setting for wind in Maine, and then 12 semi-structured questions were asked to elicit attitudes towards offshore wind and the impacts at various spatial scales. Next, interviewees were asked to take part in an immersive, multisensory virtual reality (VR) experience that simulated a 10-turbine floating wind array (Fig. 1).

Researchers helped respondents into the head-mounted display to participate in the immersive environment part of the interview. Respondents were asked a series of questions about expectations of the wind farm, perceptions of size and distance, and attitudinal questions about the floating array. Questions allowed respondents to navigate towards the wind farm starting 5 miles away: atop a cliff, at the seashore, from a boat, and then progressively closer at 2.5 miles, 1 mile, 400 ft, into the middle of the array, and into a fishing 'transit' lane. The VR scenes were intentionally minimalist to keep the focus of the participant on the floating turbine array, and were co-developed with our partner organizations and members of commercial fishing advocacy organizations.

The VR part of the interview lasted approximately 15 min. After the simulation, respondents were asked a series of questions about place-technology "fit," shifts in attitudes, and to consider any technical accommodations that might be implemented to accommodate existing ocean users. The interviews ranged from 30 to 75 min total.

3.4. Data analysis

All interviews were recorded, transcribed, cleaned and anonymized using Otter.Ai software. The transcripts were coded using iterative first and second-order coding following the principles of grounded theory [53]. Each transcript was coded initially by one of three researchers taking margin notes. Upon completion of first-order coding, the three researchers generated a codebook collaboratively including parent and child codes that were topics of interest to the researchers as well as concepts that emerged from the participants. A total of 16 top-level codes were defined with 95 child or grandchild codes. Transcripts were coded using QDA software Dedoose (v.9.2.12) by two researchers, with frequent check-ins to maintain coding consistency. The research team collectively examined the data for code co-occurrences and code application, and described major thematic concepts. A total of 17 major themes were then extracted, and the researchers wrote analytical memos on each of these, pulling together an analysis of the results including excerpts from the interviews that anchored the concepts.

4. Results

4.1. Impacts at scale

Participants' perceptions of offshore wind (OSW) development in Maine revealed perceptions of impacts that were highly variable depending on scale: state-level benefits, community impacts, and individual experiences. These perceptions were largely framed by principles of distributive justice, highlighting the need to ensure that the benefits and burdens of OSW development are equitably shared across Maine's

Fig. 1. A 2-D depiction of one scene in the 3-D multisensory virtual environment. Credit: Izge Bayyurt, INSITE Lab.

waterfront communities. At individual scales, few participants could articulate how they would personally be impacted, although there was variation among fishing and non-fishing community members. Community was the scale at which most participants carefully explained personalized impact.

4.1.1. State-level impacts: "Generate Power in Maine, for Mainers"

Two competing narratives dominated the discussion of state-level impacts of offshore wind. On the one hand, most people talked about the benefits of energy independence and affordability of local generation. On the other hand, some participants worried about privatization of the energy sector and as well as impacts to natural resources of the state, including the fishing economy. The majority of participants believed that offshore wind would be a net benefit for the state.

People spoke broadly about the symbolism of a clean energy economy and how Maine could be a leader in the deployment of renewable energy in the U.S. Others saw offshore wind as an opportunity to position Maine as a leader in innovation, highlighting the potential benefits of energy independence and Maine's role as a pioneer in renewable energy. Participants overwhelmingly alluded to a sense of pride when visioning Maine as leader in the clean energy transition; some invoked the state motto "dirigo"- to lead, suggesting that offshore wind would be a "good fit" given Maine's long marine history and values where people "take pride in our state and our environment" (FR 22). They also mentioned that being a national leader in clean energy was far preferable to oil drilling, cautioning that the alternative to offshore wind could be "oil derricks in the ocean."

Some respondents detailed the economic benefits, such as reduced electricity costs, in a state which has one of the highest electricity rates in the nation, while several others discussed the need to move away from oil, which is the most common source of heat in Maine. Several respondents referred to the benefits of electrification. Others thought offshore wind would have a positive impact on "good-paying jobs" and that it would be "a great benefit to the Maine economy," and the revenues coming to the state could be used to redistribute wealth to under-resourced communities in other parts of the state:

We - Maine - is extremely poor. So that would be a really good bonus, if this project were to go through, to make sure that the power specifically was going to the reservations because we forget about the Native Americans, and to the poorer populations.

(IR 18)

Not all participants thought that offshore wind would help the state. Some people suggested that offshore wind might increase electricity rates statewide. For example, a respondent was concerned that the cost of offshore wind would no longer be affordable "once they take the tax incentives away" (CF 19). Others suggested that Maine would not see any financial benefits, which would instead accrue to corporations, while Maine would simply be "a landing place for the power to come ashore" (FR 16). Participants expressed concerns about how offshore wind development might negatively affect Maine's identity as a rural state with a pristine environment and healthy natural resources. Negative connotations focused on threats to Maine's fishing culture: one respondent described how fishing is "really tied to Maine's culture" (IR 6) and pinpointed generalized concern for disruption to the state's fishing culture.

Only a handful of participants brought up impacts to tourism from development of OSW off the Gulf of Maine: some thought OSW would hurt tourism while others thought tourism would be benefited. Those who believed OSW would hurt tourism touched on themes such as industrialization of the ocean and that tourists would "not want to be here" because of changes to the seascape. On the other hand, a few people suggested that wind would help tourism by reducing pollution.

4.1.2. Local-scale impacts: Changing community character

Offshore wind was considered one more threat amid changing community dynamics, driven by high housing prices, cost of living, affordable housing shortages, an influx of out-of-state residents purchasing homes, lack of funding for schools, substance abuse, and health concerns. The majority of participants readily identified localized impacts from wind and circled around two main ideas: first, the effects on fishermen's livelihoods, and second, community-level benefits of economic development.

Most people in our study were highly concerned about how offshore wind and ancillary infrastructure might devastate fishermen and members of the broader seafood economy. Nearly every respondent emphasized that decimating the fishing community would be the end of the local town identity, and therefore, this was an issue of great importance across participants of all demographics.

Participants with this stance heavily associated community wellbeing with the wellbeing of fishermen, linking health of the fishing sector with local economic stability. People repeatedly referred to the fishing industry as the lifeblood of some of Maine's coastal communities. One interviewee described how some communities in Maine "rely on fishing, it's 80% of their income down there," and further noted that if "they lose fishing, they lose the county" (CF 7). Several participants talked about multi-generational fishing families and the importance of maintaining opportunities for future generations. One fisherman explained the rapid changes undergoing her community:

> [Our town] is changing at an alarming rate. We still have a strong fishing heritage that will change if renewable energy comes. It impacts the industry. The young families are not going to be locals. I think that [our town] will survive. I think there are other communities in Maine that won't.
>
> (CF 33)

On the other hand, some community members, who are not members of the seafood economy, perceive that fishing is "declining" irrespective of changes due to wind energy development. One person noted that offshore wind was being used as a rallying cry for fishermen, when in fact the industry was undergoing a larger transformation:

> I think that wind power is a good scapegoat for some of the pains. It's an easy way for people to say hey, this will hurt the lobster industry, when I think what's really hurting the lobster industry is our changing climate.
>
> (IR 6)

In fact, nearly every fisherman in our sample identified climate change as a key threat to fisheries. Many suggested that there was a great need to transition off of fossil fuels, but proposed solar, hydropower, and demand management as alternatives that were better aligned with the culture of Maine. Despite uncertainty over whether offshore wind was a good choice for Maine, most respondents acknowledged the potential for local economic development. They identified job creation opportunities for skilled workers, who presently work in Maine in maritime and shipbuilding trades, suggesting that wind would create jobs "on the waterfront" or "offshore at the actual site, or [by] maintaining it" (IR 15). However, most community members were unconvinced that the potential benefits outweigh the potential costs to the community.

Particularly poignant was the sense that the localized impacts of offshore wind had resulted in community division. This was especially true when referring to a signed agreement between a private facility to allow a subsea cable to come ashore at their waterfront property to interconnect to the grid. One fisherman explained the community divisions that had arisen were due to the way that planning and decision-making had occurred, noting that "the way that it's been handled in this community, I see the divide with people" (CF 10). Another respondent spoke about the various factions in the community and described a sort of "us against them" mentality:

> It's become very unpopular among some, but very popular among the wealthy retirees. I think they're sensitive to people just kind of saying, oh, we'll change things and you're too stupid to know there's a benefit to it.
>
> (CF 27)

Numerous respondents spoke of how neighbors had become pitted against neighbors, highlighting the deeply polarized nature of community perspectives on offshore wind.

4.1.3. Impacts to self: *"I'll feel good" vs "I can't fish"*

Personal experiences with offshore wind varied based on participants' proximity to and use of the ocean, energy priorities, and residency. People who do not rely on the ocean for their livelihood could not easily identify any personal impacts from offshore wind; however, several noted that they would feel positive about their individual contribution to the transition to clean energy in Maine. One respondent clearly explained that the development of offshore wind would "make me feel good that something was being done" (IR 25). A few participants spoke of how electricity rate changes would affect their households: some thought OSW would lower rates, but more worried about additional financial burdens if OSW increased electricity rates. Participants who were full-time residents of the coastal community stated that they would face personal impacts more than part-time residents did. Part-time residents mostly discussed personal impacts as disruption to pleasure boating or sailing, and aesthetics of ocean views. Community members were empathetic towards their fishermen neighbors, who were facing offshore wind in a more acute way. One long-time resident noted:

> I don't rely on those resources for my livelihood. Perspectives from the people that do - they feel that [wind] threatens their ability to put food on the family tables. And so for me, I'd say I'm much more separated from the impact they could have.
>
> (IR 6)

Conversely, community members who work on the water stated that they individually would be negatively impacted by offshore wind development. They spoke extensively about displacement of their fishing activities. Every fisherman in our study said that they would be personally impacted by offshore wind because they would not be able to fish in or near any array. One multi-generational lobsterman explained: "I think it's so hard for people ashore to comprehend how much the spatial area that it's going to impact people in my line of work. I can't fish around them" (CF 4).

Another fisherman who trawls offshore explained his concern that the trawl doors could fetch up on the turbine mooring lines or subsea cabling, and suggested that this could capsize the vessel; and in a neighboring fishing port, a trawlerman observed that he couldn't "get anywhere near them" (CF 2) due to safety. Finally, another fisherman explained that although his fishing activities would not likely be displaced from his preferred fishing grounds, he would experience crowding by other displaced fishermen that would be pushed into new areas to fill their fishing quotas - thus straining the entire fleet. Cabling was also a pervasive concern of a number of fishermen due to the possibility of gear snags, and several individuals expressed frustration that "they still won't tell us where they really want to run the cable" (CF 7), because cable routes and landings typically are identified much later in the development process. Finally, fishermen were concerned that construction might affect the health of the fish stocks and ecosystem function.

4.2. Institutional trust

Participants' past experiences with institutions impact whether or not they currently trust the institutions and the information they release. Trust was often tied to institutions' responsiveness to stakeholders, particularly the fishing community, while distrust stemmed from perceived lack of communication and collaboration. Respondents were highly skeptical of federal decision-making, but also utilities, state agencies, and foreign interests. We found that a perceived lack of details in siting, technical design, and opportunities for substantive engagement were strong drivers of fear, which translates into opposition. Issues regarding the public's role in decision-making, trust in institutions, and information transparency were brought up more than 400 times by respondents, twice as often as issues of distribution of benefits and burdens.

4.2.1. Factors that build greater trust

The highest levels of trust were evident among institutions that initiated frequent and sustained outreach with members of the public. These tended to be institutions that were visible in the communities and served in advocacy roles or local resource management. Several fishermen specifically identified the state marine resource department as an entity doing valuable work to protect the interests of community members while advancing the state mandate to procure energy from offshore wind. Fishermen specifically suggested that the state agency "really seems to have our best interests most of the time" (CF 4), and noted that the decision-making process to locate the State's research array was mostly successful:

I think the [Department of Marine Resources], when they were trying to site that area, did the best they possibly could, reaching out to people and getting the least invasive area. They're good at reaching out to people because they have an intimate knowledge of people up and down the coast. So they can call me up anytime they want and ask me a question. I'll tell them.

(CF 19)

Participants also noted positive experiences with fishing industry associations. These organizations were perceived as advocates for the fishing community in negotiations and collaboration, noting that "they've managed to get LMA 1 out of the call area" (CF 2), referring to the removal of the majority of federal lobster management area 1 in the Gulf of Maine from offshore wind leasing,[1] which was widely acknowledged as a major success among the lobstering community. However, non-lobstering fishermen noted that this decision "puts [wind] off onto the draggers. And there's not many of us (CF 2)," referring to the siting of the proposed wind farm out of a lobster zone and into an area used by fishermen towing a trawl net.

Trust in state resource managers did not extend to other state agencies. People spoke of the role of politics, suggesting that elected officials from urban areas were not adequately considering the realities of living in rural Maine and that focus on offshore energy is misplaced when other needs are more pressing, such as the cost of living. Some participants suggested the legislators in Maine were "more responsive than, you know, Massachusetts" when accommodating the fishing industry concerns. A fisherman explained that although he generally disapproved of state politics, he also acknowledged that the Governor had "done a solid for us with what happened with the whales" (CF 10), referring to the Governor's support of the fishing industry by standing with fishermen in opposition of federal rules to require lobster fishery modifications intended to protect North Atlantic Right Whales which could cause "undue burdens" on the lobster fishery.[2] This is reflective of how local handling of issues in the community strongly influenced perceptions of trust towards that institution.

4.2.2. Factors that led to mistrust

Sentiment towards federal agencies was more antagonistic. Multiple federal agencies play a role in offshore wind siting and decision-making: some of these agencies were familiar to marine-dependent communities (fishery management), and others were not. Several fishermen described

that they had a high degree of trust with state managers, but that trust did not extend to federal authorities who lacked long-standing relationships with local stakeholders. They were perceived as prioritizing energy development goals over community concerns. Some people have been involved in offshore wind processes in the region for several decades and described how they had heard "A lot. Yeah. I've heard all the lies. I've heard all the truths" (CF 35).

Decision-making processes for offshore wind leasing came at an inflection point where fishing communities in Maine were facing federal proposed 'take reduction' regulations intended to protect the critically endangered North Atlantic Right whales from fishing gear in the Gulf of Maine. Tensions among federal agencies and Maine fishing communities were particularly high because significant modifications to fishing gear had recently been proposed, following many years of debate over management actions. While whale and wind issues were identified by several participants as "mutually exclusive," they clearly were not. The relevance of these federal actions is two-fold. First, fishermen spoke fervently about the compounding threats facing fishing communities, including whale protection regulations and new energy infrastructure, amid changing community dynamics and increases in the cost of living. Second, the fishing gear regulations had been proposed at the same time as offshore wind surveying and construction activities had commenced several hundred miles to the south. An unusual whale mortality event had also been declared,[3] leading to widespread speculation that the offshore wind activities were associated with the mortalities. One community member explained that the whale deaths were "unexplained," and were "very close to where a lot of the [offshore wind] is going on in the mid-Atlantic" (FR 16). Although federal agencies had released a media statement that the mortality was not attributed to offshore wind,[4] perceived risk was widespread.

Distrust plus perceived lack of transparency of the energy industry and federal government increased speculation about cause and effect of mortalities. Other community members explained that it felt profoundly unfair that Maine fishermen were being restricted in their fishing activities to protect endangered whales: "a lot of people are upset when we haven't had a whale stranding in Maine lobster fishing gear, in forever" (FR 16), while the offshore wind industry was perceived as being allowed to cause mortality without consequence, speaking of incidental take authorization permits:

We're putting all these turbines in their migratory path, but yet as fishermen, we can't kill more than half a whale a year between the U.S. and Canada. Yet the offshore wind industry can kill what - 20 a year - or harm, or impact. Come on. This is insane.

(CF 10)

Of salience is that fishermen, non-fishing ocean enthusiasts, and non-water users alike were deeply distrustful of the motivations, actions, and decisions of federal entities; this distrust is rooted in a complex history of resource management and compounding stressors. It is perhaps unsurprising that members of Maine's fishing communities met new decision-making entities guarded and with skepticism.

Distrust also extended to private entities. Offshore wind was

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[1] BOEM Releases Draft Wind Energy Area in the Gulf of Maine for Public Review and Comment − 10/19/2023.
https://www.boem.gov/newsroom/press-releases/boem-releases-draft-wind-energy-area-gulf-maine-public-review-and-comment

[2] Maine Delegation, Governor Mills Announce Lifeline for Maine's Lobster Industry Secured in Government Funding Package - 12/20/2022 https://www.maine.gov/governor/mills/news/maine-delegation-governor-mills-announce-lifeline-maines-lobster-industry-secured-government

[3] 2016–2025 Humpback Whale Unusual Mortality Event Along the Atlantic Coast.
07/02/2025.
https://www.fisheries.noaa.gov/national/marine-life-distress/2016-2025-humpback-whale-unusual-mortality-event-along-atlantic-coast

[4] NOAA Fisheries to discuss East Coast whale strandings.
01/18/2023.
https://www.noaa.gov/media-advisory/noaa-fisheries-to-discuss-east-coast-whale-strandings

frequently regarded as harmful for the state because of privatization of the energy sector, giving too much control to developers that don't have Mainer's best interests at heart. They spoke about giving up control to corporations that lacked incentives and accountability to steward the resources of the state, suggesting that wind development was led by "foreign investors who are taking our tax dollars" (IR 29). One community member described how Mainers have prior experience with foreign-owned entities investing in the lumber and paper business, making money, and leaving locals to contend with the waste. They described a story familiar in the state where small communities lacking political leverage were exploited for timber harvests, resulting in a boom-and-bust industry that had left Mainers bereft and towns in post-industrial decline, and worried that offshore wind could follow a similar path.

> A lot of big companies, U.S. companies and foreign companies, look at Maine as kind of a third world nation that they can come in and, and rape [the land] and take everything away from it and leave us nothing in return. Because the paper companies came and made their money, and left all of the toxic waste. It's just I'm tired of it and I'm scared of it.
>
> (IR 29)

People worried that offshore wind developers were more focused on profits than they were about providing energy for Maine, effectively developing wind projects in order to "arbitrage [the electricity], and make hundreds of millions of dollars" (FR 30). One fisherman explained that he was supportive of developing renewable energy, but that the public is being asked to "take the government's word" that offshore wind is an effective climate mitigation strategy. He further explained that people are concerned about trusting government entities because "government is influenced by people with a lot of money" (CF 32).

Participants also shared distrust of utilities as well as expressed concern that the energy produced from OSW from the Gulf of Maine would not be going to Maine residents but instead to other states in southern New England. In particular, community members spoke with frustration about the largest utility in the state, reporting that the utility – whose parent company is overseas - was not trusted, referring to recent rate hikes, and controversy over a recent high-profile referendum where voters rejected a high-voltage transmission line by the utility, which was later constructed anyway.

Issues with transmission, grid interconnection, and cabling became another flash point in communities. Several people suggested that grid interconnection points were a place where the community most closely interacts with offshore wind infrastructure. A local institution was frequently described disparagingly after a decision to allow a subsea transmission cable to come ashore at their facility was made public. Several community members described the "outrage" they felt when they did not receive advance notice of this decision, evoking a sense of betrayal that the institution had granted access to the electric grid. Related, several people brought up a negotiated community benefits package that had been initiated by community members neighboring the cable interconnection point. The $1 M cash contribution to the community was described as something that the developers had been "forced into." While some residents lauded this as a success, several others called the agreement "hush money." Others suggested that the developer was trying to "dangle money as a carrot to buy votes" (CF 22) in order to increase support for the project, even though the benefits package had been citizen-initiated. These examples reveal fears that similar patterns will be repeated, where independent, powerful entities will make decisions without meaningful stakeholder consultation.

4.3. Transparency in decision-making

Stemming from the distrust towards past environmental initiatives at federal and private levels, many participants identified greater outreach as critical to building trust and increasing informed decision-making about OSW development. Across stakeholder groups, participants highlighted the importance of transparency and local engagement, so that offshore wind impacts are clearly understood and outreach materials are comprehensible. However, differences emerged between ocean users and non-ocean users in their outreach priorities. Ocean users emphasized the importance of inclusion in decision-making processes, driven by their lived experience. Non-ocean users, on the other hand, focused more on the need for general transparency and diverse stakeholder engagement, often based on curiosity rather than having a direct stake in offshore wind development.

Ocean users consistently expressed frustration at being sidelined in decision-making processes. Many believed that federal agencies had not adequately consulted those with specialized knowledge of marine environments, viewing outreach efforts as insufficient or superficial. One described engagement efforts as performative, rather than genuine attempts to collaborate. He suggested that offshore wind development in the Gulf of Maine was predetermined:

> I think [wind turbines] are gonna come here, whether we think it's a good idea or not. And whether they cause damage to the environment out here, I don't think that matters. I don't think it matters to the federal government. I don't think it matters to anybody. I think that they've made up their mind that this is the way to go. And we're going to take it.
>
> (CF 19)

Expectations for engagement differed from how public meetings were implemented. Several fishermen spoke about how they had been excluded from planning and decision-making processes, explaining that they "don't feel as if they're consulted" (CF 31). Many felt that they were treated as "uneducated fishermen" even though they could speak authoritatively about the health of the ocean ecosystem. Other individuals suggested that the fishing industry had not been represented in decision-making, and described being told at public meetings they had attended that conversation was for decision-makers only, while everyone else was only allowed to listen. A fisherman explained the mounting frustration with public engagement processes, relating a recent experience at a federal meeting for offshore wind planning:

> What I hear all the time is 'we want to hear from you.' Fishermen showed up with questions, and they said, 'There are note cards in the back. Write your question on a note card and we'll read your question.' So it's like, we're not even allowed to ask a question ourselves anymore. It's just not a friendly environment, you know, when you're looking for feedback from people.
>
> (CF 4)

Multiple respondents described similar stories, where they had taken a day off work to attend a public meeting or outreach event, only to find that there were no public input opportunities to provide input or leverage their voice. They were extremely frustrated at the lack of clarity around substantive outreach efforts: "They don't explain that process. They don't explain it at all. And then they wonder why we're all pissed off" (CF 10). Our own past experience at various public meetings corroborates this: we observed that opportunities for the public to respond to a decision or ask questions were sometimes quite limited or nonexistent and were occasionally adversarial.

Others spoke about how mandated community engagement efforts were perceived as insufficient, that agencies "won't engage - they don't have to," and that federal community engagement standards are "not very specific," "not binding," and "take years" to achieve any outcomes. Several people emphasized that outreach is not just about addressing current concerns but also considering how future generations will be included in the decision-making process. A member of the fishing industry explained that even if his fishing operations would not be directly displaced by wind, he continued to participate in outreach efforts to "fight for future generations" (CF 4). Some community members offered

anecdotes showing their personal initiative to fill the outreach gap, such as posting public documents to social media to disseminate information because they didn't believe that public institutions were doing so. Other people suggested that the government was "rushing into this a little too fast" (CF 2), and it was hard for community members to keep up with many steps in the decision-making process.

Many community members - mostly those who were not dependent on the marine economy - were unaware of recent offshore wind planning efforts and had not participated in outreach efforts for offshore wind. Yet, they spoke extensively about their desire for outreach to clear up these concerns about logistical, economic, and environmental uncertainties. They tended to ask questions more related to ownership and access, such as "who owns the ocean?" and "who gives permission for this?" Importantly, several community members felt that they had little stake in the game, but they wished for more outreach on behalf of those who would be directly impacted. They advocated for outreach that engages a diverse range of groups, including fishermen, scientists, and community members, to ensure inclusive decision-making processes and transparent information dissemination. Some believed that better outreach could help resolve conflicts and community resistance, suggesting that fishermen are "open-minded" but that "they're not included in the solutions."

Despite these frustrations, community members from all backgrounds indicated a willingness to work alongside decision-makers. Many also supported innovative outreach methods, such as virtual reality tools, to bridge gaps in understanding. Many expressed gratitude for the opportunity to share their thoughts during interviews, highlighting the importance of creating spaces for open dialogue.

4.4. Information gaps and uncertainty

Concerns over environmental impacts were widespread. Nearly every respondent self-identified environmental concerns as one of the top issues when considering whether the tradeoffs of offshore wind were worthwhile. Supporters and opponents alike equivocated about the magnitude of impacts, several of whom wondered, "Do the pros outweigh the cons?" Ocean users and non-ocean users expressed a desire for more information so that they could more effectively weigh in on public policies. Many participants felt that they were not being provided with enough information to reach their own conclusions or contribute to discussions on offshore wind. One respondent explained that "there's a lot of anxiety over the impact to our environment, to our fisheries, to our people. I don't know that the pros outweigh the cons. It seems like there's been a lot of unanswered things happening" (FR 16). Another fisherman explained that the uncertainties over impacts generate fear over unknown futures, stemming from a perceived lack of accessible and comprehensible information that has been presented to stakeholders. He said: "Every researcher says the same thing, 'we don't know,' which - I'm not gonna lie - scares the hell out of us" (CF 4).

This suggests that information about OSW is either not sought out, not easily found, not trusted, or not in the public domain. Although the relationship between information access and trusted institutions was not discussed with participants, we find that the lack of trust among institutions that typically provide information (developers and governmental regulatory agencies) is notable. To address these concerns, several participants emphasized the importance of access to information. Many participants referred to the usefulness of the VR environment in helping to answer some questions about size and scale of wind turbines, suggesting that new forms of information access are needed. In fact, the majority of respondents suggested that they wanted more information before forming an opinion about offshore wind. Other people spoke about how fears had been amplified when questions about environmental risk were posed and went collectively unanswered by scientists.

> I think a lot of the tension in the community is just fear-based - that they're not fully understanding [the risks]…if there's more education for everybody involved, then I think that that fear, just like anything will, will start to dissipate.
>
> (IR 15)

Many participants who did not identify direct impacts to themselves suggested that there was an information gap that was leading to fears and misinformation. People suggested that decision-makers should "come up with more factual evidence" (CF 35) to alleviate fears of perceived impacts such as bird strikes, whale strandings, or how electromagnetic fields affect marine life. A few people suggested the need to diversify the sources of information being provided, critiquing that information is shared from a scientific research perspective, rather than a lived experience perspective. One fisherman in particular emphatically exclaimed that "the actual working knowledge of what our ocean is, cannot be taught in the classroom or in any book" (CF 4), recommending that researchers should combine lived experience into impact evaluation to supplement academic research.

Finally, a troubling finding was that several people explained that they had chosen not to engage in public decision-making processes because they felt that "not knowing the entire plan, only knowing bits and pieces" (FR 16) disqualified them participating in events like public hearings, information sharing sessions, and other organized sessions intended to broaden participation or to gather local feedback on proposed developments or actions. Others explained that they were self-conscious about their lack of understanding about offshore wind, and had opted to not participate in public meetings because they perceived that their lack of knowledge about wind energy meant they had little to contribute to public discourse.

5. Discussion

Impacts to various ocean users and marine-dependent communities are critically important considerations to floating OSW planning and development processes if offshore wind is to contribute to climate mitigation in a just and equitable way. Impacts may be tangible in ways such as lost revenue or increasing space-use conflict, or in non-quantifiable ways, such as changing the seascape or cultural practices. Our findings suggest that perceptions of energy justice are powerful conceptualizations driving the narratives around offshore wind in Maine fishing communities. The distribution of benefits and burdens, as well as fair process, are important to community members.

5.1. Procedural and distributive energy injustice

Our first takeaway from this study is that procedural injustice appears to play a greater role in opposition to offshore wind in marine-dependent communities than distributive justice. Offshore wind is widely expected to palpably impact people who are employed in the fishing economy [3]. If certain people (at-sea fishermen, for example) might be disproportionately affected by offshore wind, this may constitute distributive injustice. Distributive injustice was addressed by most interviewees, which was framed predominantly by acknowledging no expected impacts from offshore wind to themselves, but a perception of disproportionate impacts to other community members - almost exclusively referring to fishermen. While fishermen might have noted that their activities would be limited and that they would not be able to fish in an offshore wind array, few said that their own at-sea activities or preferred fishing grounds would be impacted. Rather, they noted widespread concern for other fishermen who *would* be personally displaced. For example, not all fishermen are similarly positioned in power and in OSW impact. Lobstering far exceeds the value of non-lobstering harvest in Maine [54], and important lobstering grounds were protected from wind development, whereas other fisheries directly overlap with proposed wind energy development areas. Future work should

investigate the inter-fishery values and fisherman-fisherman allegiance.

However, more pervasive than distribution of burdens were the frustrations stemming from perceptions of unfair processes: institutional (mis)trust, lack of transparency, information sharing, and predetermination. These are broadly conceptualized as perceived procedural injustice. People spoke of issues of trust, decision-making processes, and transparency far more than distributive issues. Also, issues of procedural justice were discussed with fervor: interviews were highly charged when discussing offshore wind planning processes, and almost every respondent was certain that community members were not fairly considered in decision-making. Fishermen widely cited how they viewed a just outcome: adequate outreach and information sharing. However, this outcome was not a reality, as fishermen perceived a lack of transparency and willful withholding of information, which were strongly associated with negative attitudes. Achieving procedural justice depends in part on how developers choose to implement engagement in practice: developers typically choose minimal engagement that informs/consults rather than empowerment [10]. Our findings are consistent with other studies that demonstrate that fishermen may view public engagement to be performative box-checking exercises [33,46,47].

Seeking a just energy transition is a moral imperative that policymakers should strive for. More pragmatically, a just process and the distribution of benefits and burdens are associated with acceptance of energy technologies [55]. For example, studies have shown that acceptance for offshore wind is influenced by the perceived distribution of costs and benefits, who bears the risks, and who benefits from wind development [56]. One of the pillars of acceptance is socio-political: whether people believe that key actors have "public-serving motives" and trust in government [24]. Attitudes towards wind energy development are associated with trust in government [25] and perceptions of fair decision-making processes [45]. Other scholars have found that people perceive more impacts from wind energy when they believe the decision-making process is unfair [57]; or that people view benefits as valid only if fairly and transparently allocated [33].

Perceptions of a fair process may also be associated with the structural design of planning. Offshore wind is planned primarily at the federal level, which differs from other planning models that are more state or local. Structural differences in decision-making can lead to perceptions of procedural injustice because stakeholders may have different expectations of public engagement based on prior experiences [45]. Alignment of expectations of engagement and reality of engagement is associated with trust, and trust is associated with acceptance of offshore wind [44]; a finding mirrored in other renewable industries such as large-scale solar [58].

Wind energy planning has long been criticized for implementing the decide-announce-defend model [59]; ceding control or decision-making to members of the public is not common in U.S. wind energy planning [60]. However, in Maine, fishing community members are accustomed to working closely with the State Department of Marine Resources. In fact, the highly-valuable lobster fishery is co-managed by fishermen and has been a global exemplar for fisheries management success [61]. Recently, Kashwan & Lee used process tracing to track federal government actions and engagements in Maine's offshore wind planning, and found that although the government touted the importance of early and frequent public engagement, the 13-year-long process was top-down and led to a high degree of frustration, distrust, and cynicism among the fishing industry [62]. Federal decision-making follows a carefully executed public outreach process with opportunities for feedback, but they retain status as "powerholders" with discretion of whether and how to integrate feedback into future decisions [62]. Elmallah & Rand noted that public officials consider outreach and engagement to be a success if the necessary steps were followed and the public was afforded opportunities to weigh in, but other stakeholders view mandated actions as insufficient [45]. Perceptions of injustice can thus stem from a misalignment of expectations and experiences of a public engagement process [63].

5.2. Importance of trusted, local institutions

Our second major takeaway is that trust in local decision-makers enables meaningful dialogue and co-design of solutions, whereas a lack of trust or prior distrust impedes such conversations and exacerbates division. Participants spoke postively of community meetings and individual conversations that were led by resource managers and fisheries industry associations, and generally concurred that the outcomes were generally agreeable, even though those managers lacked decision-making authority for offshore wind development. For example, just a few months prior to data collection, the State of Maine had released its offshore wind "roadmap," which included a fisheries working group [64], and siting for Maine's 144-MW "research array" had been recommended to the federal government by the state [65]. The siting decisions were frequently discussed by members of the fishing industry as a success, because they valued the dialogue, trusted the process, and importantly, trusted the institution leading the outreach.

Community members have trust in local decision-makers and resource managers with whom they have relationships, and are much more willing to work with trusted entities towards a solution than they are with entities with whom they do not have trust, such as some federal decision-makers, state policymakers, or private firms; consistent with findings of other studies [33]. Fears of privatization of the energy sector were evident in the narratives, where people worried about ceding control to private firms, and the frequent references to abandonment of mill towns by foreign entities. This also came up in the concerns for "arbitrage" of the electricity out of state. The widespread concern for climate change and the need for energy transitions reinforces that members of fishing-dependent communities are open to offshore wind, but are deeply skeptical of the messenger and the motivations of those entities. This suggests that federal agencies and private developers should consider models of public engagement by leaning into partnership development with trusted agents. We find that trust in federal regulatory agencies and private wind developers is quite low, although this was exacerbated by parallel federal actions (i.e., whale take-reduction measures).

Other studies have identified that *some* federal decision-makers are trusted entities in offshore wind planning, but the most trusted institutions were fisheries advocacy groups [66]. Other researchers identify locally-owned private wind developers as trusted entities [25], but Smythe's study of multi-national developers did not [66], as we also found. Our institutional trust findings are consistent across different infrastructure development projects that affect host communities, such as solar [67]. We suggest that trust is driven by prior history and local context, and it is imperative to identify trusted institutions that may play a neutral role in enabling constructive dialogue. The abundant discussion around whale impacts suggests that peer networks may be driving risk framing, possibly amplifying the risks of offshore wind to whales as messaging circulates popular media [68]. This also suggests that peer and local networks may be more trusted than federal regulators. Distrust among Maine fishing communities and fisheries managers is long-standing and is well documented, especially with respect to whale protections [69].

Thus, there is a role for trusted institutions to broker honest conversations and fair process, distribution of benefits and burdens, and local impacts and local goals for the energy transition. These institutions may be bridging or boundary-spanning institutions: neutral entities that can perform conflict resolution, offer leadership in negotiations, and build collaboration and trust. Environmental bridging institutions are able to communicate across disciplinary boundaries and provide leadership in group settings [70]. Such institutions were absent in a nearby region debating offshore wind, where tensions were high among fishing industry and fishing-dependent communities and offshore wind development [66]. In this study, our team (of academics) was immediately placed in this role by the public during data collection; many interviews were followed by long conversations and Q&A by stakeholders. Through

the process of interviewing, we identified that the public is seeking a trusted partner to communicate and disseminate information.

5.3. Knowledge, education, and information accessibility

Curiosity about offshore wind was pervasive. OSW was frequently in the media at the time of data collection, with parallel state and federal planning processes that were underway after nearly two decades of attempted projects, and there was a feeling that development was imminent. People with negative and positive attitudes alike were rife with questions about OSW planning, technology, environmental impacts, and more pragmatic questions about siting, scale, and size of projects. During interviews, participants were actively asking questions that were beyond the scope of our research, and were highly specific to their personal situation. For example, interviewees asked if residents would receive local benefits, such as rebates or job opportunities and how offshore wind might affect migratory patterns of fish and birds or disrupt existing fishing activities. In some cases, answers were known and resources were provided, and in others, the VR environment provided an appropriate medium for answering questions about size and scale. In other instances, respondents pointed to open questions that will remain unanswered until offshore wind is built in the Gulf of Maine. A lack of accessible information not only limits public understanding but also restricts stakeholders' ability to provide informed input, undermining the procedural fairness of OSW development. Addressing these gaps through timely, transparent, and considerate engagement could foster trust and empower community members to help shape the future of offshore wind in Maine.

We cautiously suggest that there is a deficit of information, and more transparency and information sharing would be helpful. Caution is two-fold. First, information dissemination can be a tactic used by developers to "satisfy" public engagement. Second, the knowledge deficit framing can be used to dismiss opposition [71] - akin to assigning a "NIMBY" label which devalues underlying and legitimate concerns that people have about wind energy. Belief that providing information increases support is erroneous. However, information access is still critical to improve transparency, empower stakeholders who would like to participate in public engagement, and improve collective decision-making [72]. We acknowledge that while there is already published research on offshore wind — and more work underway — some information is highly technical, not freely available, or there is an absence of trusted channels for sharing information. This highlights the need not only to produce accurate information, but also to share it in a manner that is clear and credible for diverse communities, and considers how trusted third-parties can support education and knowledge-sharing [10].

We also note that almost every participant who was familiar with federal decision-making about offshore wind was frustrated with the step-wise approach for selecting areas for federal leasing. The process involved a large majority of the Gulf of Maine to initially be considered, but then iteratively winnowed down to a small area. Though intuitive to policymakers and regulators, the changes were alarming for people who were unfamiliar with the process, and many had only seen the early maps that seemed to designate much of the Gulf of Maine "open" for offshore wind. It was a double-edged sword - more transparency in the mapping led to more resistance and then confusion as the areas considered were changing. Simply putting spatial information out there to stakeholders is not enough - when, how, why, and through what specific channels it is communicated makes a difference. Studies to investigate the tradeoffs of planning information transparency and effective information communication are worth investigating in future research studies.

We acknowledge some limitations to this study. First, there is selection bias in respondents. Although we recruited broadly and with help from stakeholders and from our project partners, we likely over selected participants who are particularly interested in offshore wind, and missed others who are more neutral or less involved or

knowledgeable about energy development. Related, many fishermen were concerned about others being displaced, but most did not state that their own activities or preferred fishing grounds would be impacted. We expect that there are other fishermen who may have their fishing directly impacted that we did not reach. Thus, our conclusions should be viewed with the caution of any opportunistic sample, which may not represent the entire community of interest. Finally, we do not report the full methodology, results, or findings of the VR portion of the interview in this paper due to space limitations, and the different methods that were used in the data analysis for the questions that were administered in the headset. A full reporting of these results is beyond the scope of this paper, which we save for future work.

6. Conclusion

Offshore wind has the potential to significantly contribute to the energy transition in the U.S. and beyond. While many studies have demonstrated the promise of offshore wind, the disproportionate benefits and burdens must be understood at local scales. In particular, impacts to marine resource-dependent communities are uncertain. Maine presents an interesting case due to the strong dependence on marine resources in the local economy, as well as the strong cultural heritage associated with fishing-dependent communities. Our study shows that members of fishing communities in Maine seek to better understand leverage points in decision-making for offshore wind.

We identify widespread concern about cumulative impacts should offshore wind be developed at larger scales. Issues of procedural and distributive justice, or injustice, are pervasive among members of the fishing-dependent communities. Factors such as information access, trust in decision-making institutions, and transparency drove home the conceptualization of benefits and burdens. We advocate for a transparent and inclusive decision-making process for offshore wind in the Gulf of Maine and beyond. Findings also suggest that novel decision support tools, such as our immersive, virtual reality module, was instrumental in helping community members conceptualize what is meant by a floating offshore wind array. Using tools to support spatial data access improves transparency and opens lines of communication with stakeholders. The role of VR in attitudinal research to better understand the interaction of future infrastructure and new technology should be an area of future research. In particular, VR offers a novel way to conceptualize the impacts of future technology on current and historic use of land and sea. Finally, we suggest, as many others have, that more inclusive decision-making is necessary if we are to realize a successful and just energy transition.

CRediT authorship contribution statement

Alison Bates: Writing – original draft, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization. **Stacy A. Doore:** Writing – original draft, Software, Resources, Methodology, Investigation. **Emma Rothwell:** Writing – original draft, Investigation, Formal analysis. **Sarah Doore:** Writing – original draft, Formal analysis.

Declaration of competing interest

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

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Appendices. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.erss.2025.104286.

Data availability

The data that has been used is confidential.

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