



Review

The evolution of equity in offshore renewable energy: A systematic literature review



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ARTICLE INFO

Keywords:

Offshore renewable energy

Ocean equity

Energy justice

ABSTRACT

Offshore renewable energy (ORE) projects are becoming a promising solution in transitioning to cleaner energy, but there are important questions regarding the governance and policy goals of such projects, particularly given frequent opposition from local communities who do not believe these projects lead to equitable benefits. This study explores the relationship between ORE and equity, analyzing how the concept of equity has been conceptualized over the last two decades. A systematic review of this scholarship shows that research from various disciplines has investigated and narrowed the broad concept of equity to a few core considerations, but these have not yet been specifically integrated to inform ORE. These equity considerations have so far evolved through three stages. First, the initial focus was on the cause-and-effect relationships between public perception, conflicts, and acceptance, showing that divergent stakeholder perceptions of ORE can lead to social conflicts, and consequently, low public acceptance. This highlights the importance of recognition justice to ensure that all stakeholder perspectives are acknowledged and valued. The second stage sheds light on public engagement as a potential solution for converging different attitudes towards ORE. The third stage introduced the concept of energy justice into ORE equity studies, emphasizing the need for equal consideration of energy justice principles. Based on this, we recommend that research and development in ORE adopt a context-appropriate definition of equity and use transdisciplinary methods to facilitate collaboration and integration on unique local social, economic, and ecological conditions. In addition, future research should strive for flexible ORE processes that encompass all principles of energy justice and minimize negative trade-offs by prioritizing local goals. These strategies aim to ensure ORE projects are developed with a strong emphasis on equity and justice that can enable a transition to cleaner energy while respecting local goals and redressing past injustice.

1. Introduction

Renewable energy is a linchpin of the United Nations' Paris Agreement to reduce greenhouse gas emissions and adapt to and mitigate climate change impacts (United Nations Environmental Programme, 2020). However, countries have failed to reduce fossil fuel consumption, which accounts for approximately 25% of global emissions (Jenniches, 2018; Richardson et al., 2022; United Nations Environmental Programme, 2020), and in 2022, global energy-related CO₂ emissions grew by 0.9% and reached a new high of over 36.8 billion tonnes (International Energy Agency, 2023). Therefore, a structural shift in the energy system from fossil fuel to sustainable and secure forms of

renewable energy supply is necessary to achieve a global net zero-emission energy system (Álvarez et al., 2022; Lange and Cummins, 2021; Park et al., 2022a; REN21, 2019). Sources of energy from oceans, including offshore renewable energy from wind, tides, and waves, can make a significant contribution as it is a clean, reliable, abundant, and sustainable energy source (Kerr et al., 2014; Melikoglu, 2018) with the potential to benefit coastal economies more equitably if done well (HLP, 2020; Sumaila et al., 2019).

As countries scale up ORE facilities (Park et al., 2022a), many proposed projects have faced opposition from various stakeholder groups (Colton et al., 2016; Kularathna and Takagi, 2018). Resource-rich interest groups may co-opt ORE for their own benefit at the expense of

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minority stakeholders with limited political power or socioeconomic status (Morrissey, 2022), and evidence to date shows that ORE projects do not automatically result in local societal benefits (Cisneros-Montemayor et al., 2022; Freeman, 2020). Therefore, expanding ORE requires a concerted effort to understand the relationship between equity and ORE projects (Middlemiss et al., 2019) to facilitate stakeholder agreement and the implementation of equitable ORE projects. Equity is defined here as “the redistribution of resources and opportunities to ensure that people who have been and are presently marginalized by systems of oppression have outcomes comparable to those who are privileged by these systems” (Okamoto and Doyon, 2024, p. 10). The concept of equity can have a broad definition based on the specific context, individuals, or groups it pertains to, the location of consideration, the timing of discussion, and how it is implemented (Crosman et al., 2022).

Despite the growing recognition of equity’s central role in all stages of ORE development—and indeed of the ocean economy as a whole (Österblom et al., 2020)—the literature on ORE has primarily focused on environmental effects (Buenau et al., 2022; Coping et al., 2020), economic impacts and feasibility (Bhuiyan et al., 2022; Jenniches, 2018), or technical engineering aspects (Soukissian et al., 2017). Public commitments to improving community well-being through ORE projects have often not explicitly considered social equity aspects. This oversight is evident in the limited stakeholder participation and the unequal representation of different groups, including Indigenous communities (Cisneros-Montemayor et al., 2022; Kerr et al., 2014). Discussions on the relationship between ORE and public engagement have emphasized that, although the public engagement processes for ORE are to some extent similar to those of onshore energy infrastructure (Wiersma and Devine-Wright, 2014), there are important differences we should consider. These include lower public knowledge of ocean-specific requirements and technologies, and the prevalence of multi-use spaces, stakeholders, and potential conflicts.

Energy justice emphasizes prohibitive and affirmative principles. The prohibitive principle states energy systems should be designed to avoid interfering with people’s access to basic goods. The affirmative principle aims to ensure that energy services are available to help secure those goods (Savacool et al., 2013). Banerjee et al. (2017) build on these ideas and illustrate that energy inequities span temporal, economic, sociopolitical, geographical, and technical dimensions. Other research has considered the human dimensions of hydrokinetic energies (e.g., waves, currents, rivers), including public perceptions and social acceptability, public conflicts, stakeholder participation, and community costs and benefits (Ruano-Chamorro et al., 2018). Despite this, we still face uncertainty regarding the feasibility of implementing different compensation schemes to enhance distributional justice and social acceptance (Ruano-Chamorro et al., 2018).

Given the context-dependent nature of equity considerations, some review papers have focused on specific aspects of equity that are easier to define. For example, Cheng et al. (2021) proposed a conceptual framework that integrates renewable energy, poverty alleviation, and sustainable development goals. They suggest that energy indicators should reflect equity aspects such as health, security, and access when focusing specifically on meeting basic social needs, especially for the rural poor. Similarly, Jenniches (2018) reviewed equity in the regional economic impacts of renewable energy sources (RES) and highlighted the necessity of shifting from national to regional evaluation due to the decentralized nature of many renewable energy resources. Jenniches further suggested a guideline for conducting a regional impact assessment that emphasizes considering regions’ unique characteristics and resources, which may include the availability of certain types of RES, the existing infrastructure for energy production and distribution, and the socio-economic conditions of regions.

Another review paper focused on technical perspectives that incorporated social criteria and participation mechanisms into renewable energy decision-making processes and identified nine social impact

criteria, including employment, social acceptance, social development, health impact, governance, visual impact, knowledge and awareness, cultural value and social justice (Estévez et al., 2021). A related review by Caballero et al. (2023) focused on energy justice and coastal communities and offered an interdisciplinary development framework for marine renewable energy. This framework includes theoretical approaches from energy justice (Jenkins et al., 2016), social frameworks for projects considering the multi-dimensional aspects of wellbeing (Smyth and Vanclay, 2017), and social life-cycle assessment (Fortier et al., 2019). The framework requires decision makers to consider four main social dimensions—people, housing and livelihoods; community engagement; culture, land, and water; and infrastructure and environmental impacts—across four project phases of design, installation, operation and maintenance, and decommissioning (Caballero et al., 2023).

Discussions on the importance of equity in the ocean economy, including ORE, are relatively recent yet rapidly gaining recognition (Bennett, 2022; Bennett et al., 2019; Cisneros-Montemayor et al., 2022; Österblom et al., 2020). However, equity has received limited attention in past reviews on ORE, which have tended either treat equity in a generalized manner (Banerjee et al., 2017; Ruano-Chamorro et al., 2018) or focus narrowly on specific concepts, such as public engagement (Cheng et al., 2021; Estévez et al., 2021) or economic perspectives (Jenniches, 2018). In addition, the distinction between the social influences of renewable energy projects on land versus at sea is generally overlooked, despite significant disparities in the social and biophysical characteristics of marine and terrestrial environments (Kidd and Ellis, 2012). These differences may have important implications for conceptions of equitable processes and outcomes, including power hierarchies, marginalization, ethnicity, race, gender, and biophysical characteristics that potentially influence the nature and outcomes of ocean governance interventions (Crosman et al., 2022).

This study examines the link between equity and ORE through a systematic literature review to address the following question: How has equity in ORE been conceptualized in previous studies over the last two decades? Through answering this question, we discuss how current trends can be shifted toward an equitable ORE process by providing recommendations to address existing gaps and reduce inequities.

2. Methods

This research employs a systematic literature review, a comprehensive and replicable summary to answer a research question within a well-defined scope (Reid et al., 2017), following five main phases (Sovacool et al., 2018). The first phase is crafting explicit research questions. We defined the research question as “How has equity in ORE been conceptualized in previous studies over the last two decades?” The second phase is systematically searching the available literature using defined search terms. At this stage, relevant keywords were formulated as a Boolean search string and were searched within titles, abstracts, and keywords on three online bibliographic databases: Web of Science, Scopus, and ProQuest. Finally, 72 peer-reviewed articles were selected (Fig. 1). The third phase is using explicit criteria for including or excluding studies. In this phase, a two-stage review process was conducted. Initially, technical criteria, such as publication years, languages, and document types were used. Subsequently, there was a deeper review to verify the quality and relevance of the papers. In the fourth and fifth phases, we conducted two types of content analyses: a technical and bibliographic analysis and an ORE-Equity research progress analysis. Both analyses were conducted in a VOSviewer environment. (Detailed information for each phase can be found in Supplementary Material 1).

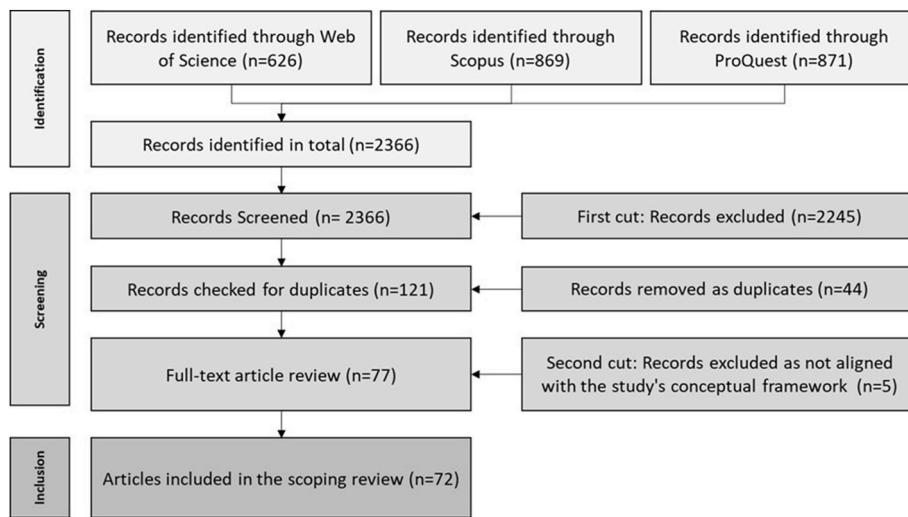


Fig. 1. Article selection process from literature review.

3. Results

3.1. Technical and bibliographic analysis

We retrieved 2366 articles in total and only included 72 publications in the analysis. These publications on the ORE-Equity nexus are mainly from 2007 to July 2023. This starting point could be attributed to several international events and treaties around this time, like the Kyoto Protocol in 2005 that operationalized the United Nations Framework Convention on Climate Change (United Nations, 1998), or the Bali Road Map that was adopted following the 2007 United Nations Climate Change Conference (UNDP, 2007). The number of publications increased almost fivefold from 2007 to 2017 and reached tenfold in 2022. The number of published papers in the first seven months of 2023 is ten, equal to the whole papers in the previous year. Although the publication trend steadily increased over the entire period, it reached a new peak in 2015, which is attributed to the Paris Agreement and countries' commitments to reducing emissions (United Nations Environmental Programme, 2020). Fig. 2 illustrates the number of publications and frequency of keywords in related articles from 2007 until 2023.

The 72 articles were published in 20 different journals (appendix 1), with authors from diverse backgrounds but primarily environmental

and natural science and economics. Researchers have examined different target groups (public, fishers, tourists, and Indigenous communities) and various case studies in developing and developed countries. Table 1 presents an overview of the journals, the most common backgrounds of the first authors, the global distribution of research case studies, and the target groups examined.

3.2. Keyword co-occurrence hotspot analysis

There are almost no articles discussing the concept of equity directly, instead, research explores various equity-related considerations in the context of ORE. The most frequent ones are public acceptance (45 times), attitude (32 times), public perception (22 times), and engagement (23 times). Fig. 3-a illustrates four clusters of equity considerations based on the frequency of their co-occurrence within the selected articles. In addition, Fig. 3-b shows how these co-occurrences have evolved over the past 20 years.

The red cluster includes studies on different blue economy sectors, including ORE, fisheries, and aquaculture. These studies aim to facilitate the coexistence (Reilly et al., 2015; Schupp et al., 2021) of blue economy sectors by developing public engagement, co-management, or co-location approaches (Haggett et al., 2020). To enhance equity, these studies focus on increasing the compatibility between different sectors

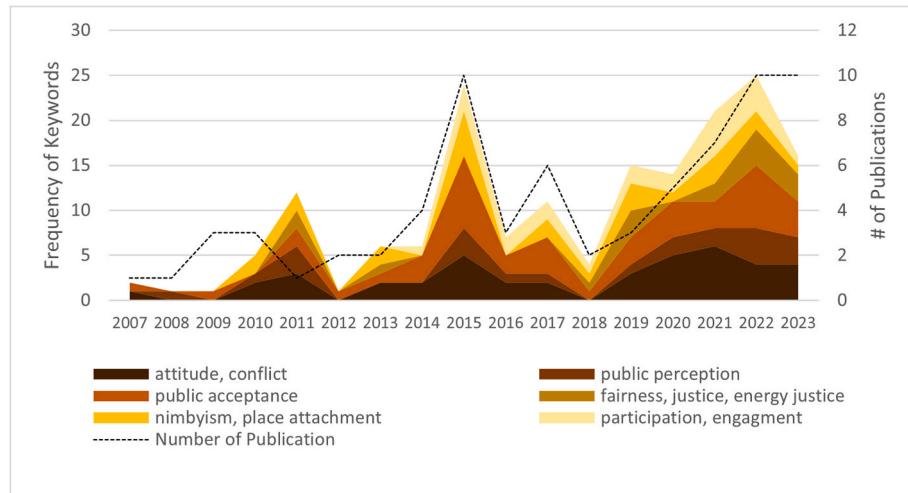


Fig. 2. Number of publications and frequency of social keywords in ORE research articles by year.

Table 1

Bibliographic analysis of the 72 articles, summarizing journals, researchers' backgrounds, target groups, and the global distribution of research case studies.

Journals	%	Research Backgrounds	%	Target groups	%	Global distribution of case studies	%
Energy Policy	20%	Environmental science/Natural science	30%	Public	75%	US	33%
Energy Research and Social Science	20%	Economics	19%	Fishers	10%	UK	26%
Marine Policy	18%	Marine affairs/public policy	15%	Tourism and Recreation	10%	Europe	26%
Journal of Environmental Policy & Planning	7%	Social Science	14%	Indigenous Communities	4%	Asia	11%
Estuaries and Coasts	4%	Geography	9%	Others	1%	Canada	2%
Frontiers in Energy Research	4%	Planning	9%			Others	2%
Journal of Environmental Planning and Management	3%	Others	4%				
Local Environment	3%						
Others (including 12 different Journals)	21%						

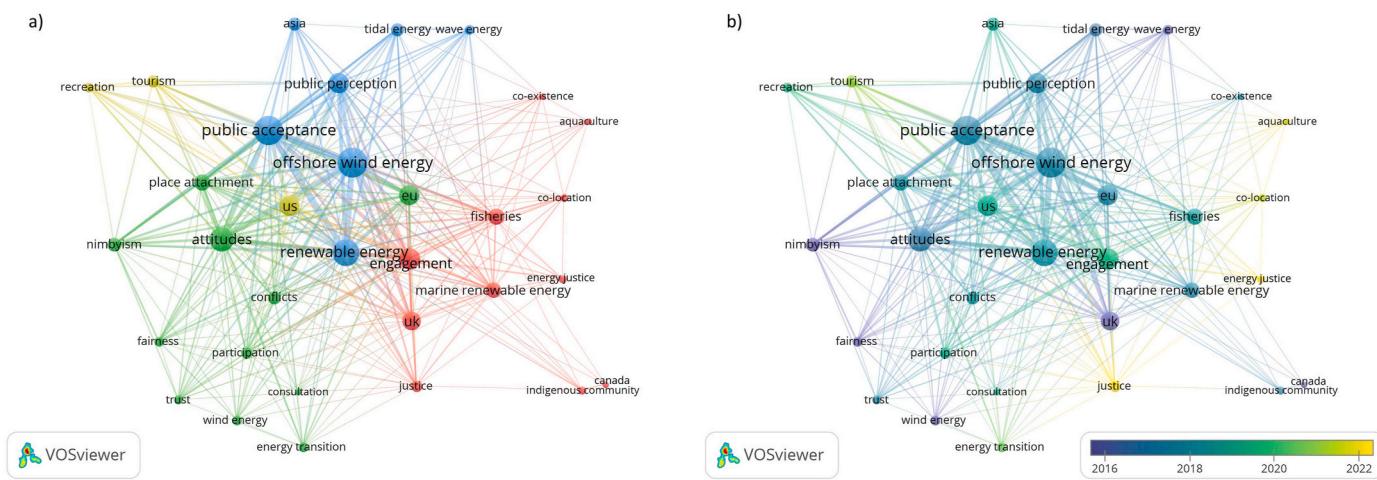


Fig. 3. Mapping of ORE-equity keywords a) Co-occurrence network of ORE-equity keywords, and b) Average publication timeline of ORE-equity keywords.

by mitigating conflicts of interest. Research articles focusing on case studies from the UK are the most related examples for this cluster (Withouck et al., 2023; Getor et al., 2022; Glasson et al., 2022; Haggett et al., 2020; Boudet, 2019; Rydin et al., 2018; Hattam et al., 2017; De Groot and Bailey, 2016; Reilly et al., 2015; Soma and Haggett, 2015; Teisl et al., 2014; B. J. A. Walker et al., 2014; Alexander et al., 2013; Devine-Wright, 2011; Bailey et al., 2011; Jones and Eiser, 2010; Devine-Wright and Howes, 2010). This cluster also encompasses the concepts of justice and energy justice. Bacchiocchi et al. (2022) emphasized the importance of recognitional justice in the development of ORE within Indigenous communities. Tyler et al. (2022) examined distributional justice, focusing on community benefits and preferences. Additionally, Dwyer & Bidwell (2019) explored procedural justice and emphasized the importance of public engagement processes in energy project development.

The blue cluster focuses on public perception and public acceptance of ORE projects, especially offshore wind and tidal energy. The main challenges identified in this research group include the lack of information about ORE projects (Ramachandran et al., 2020), being in the initial stages (Lim and Lam, 2014), and subsequently, unclear public attitudes toward ORE (Ramachandran et al., 2020) that lead to social conflicts (Chen et al., 2015; Park et al., 2022b). Research articles focusing on Asian case studies are prominent examples of this cluster as most of them, like in Taiwan, Indonesia, and Malaysia, are in the first stages of ORE development. In these studies, social acceptance is considered a function of social perceptions (Chen et al., 2015), influenced by factors, such as age and education, information provision (the source of information), stage of ORE development (Ramachandran et al.,

2020), and economic benefits and burdens (Lim and Lam, 2014). Although Asian countries are developing and expanding ORE through public participation or engagement (Park et al., 2022b), there is little to no research that directly addresses equity or justice, or all co-related research keywords.

The yellow cluster includes research article keywords that examine equity considerations in ORE from the perspectives of non-local users. Scholars have primarily focused on primary stakeholders, such as commercial fishing or local communities, as their target groups. However, only a few studies on the U.S. case studies consider the impacts of ORE on external stakeholders, like anglers and tourists (Bidwell et al., 2023; Smythe et al., 2020, 2021). The importance of including externally influenced groups becomes evident when the attitudes of local and non-local stakeholders toward the same activity can be different from each other (Ladenburg, 2010). For instance, while most local fishers oppose ORE development (Reilly et al., 2015), recreational anglers may have a more positive attitude toward it (Bidwell et al., 2023).

The green cluster explores potential conflicts and paradoxes in energy transition processes (Korsnes et al., 2023). These conflicts arise from exclusionary community consultation, the wide information gap between different stakeholders, and high resource dependency among local communities, which directly impacts people's livelihoods (Brannstrom et al., 2022). The bond between livelihoods and the environment fosters strong emotional and cognitive connections to a place that influences people's attitudes toward ORE (Brownlee et al., 2015). As a result, researchers, mostly in the US and Europe, consider place attachment as a key factor that leads to varying levels of ORE acceptance (Brownlee et al., 2015; Johansen, 2019; Reilly et al., 2015).

Our findings indicate a general lack of explicit integration of the equity concept in ORE, including in the context of a Blue Economy, which ideally prioritizes social concerns (Fig. 3-a). However, the average publication years of articles reveal a significant and growing body of scholarship—in energy justice, development economics, and marine science—that has explored relationships between ORE and equity considerations. Based on Fig. 3-b, we identify three key development stages within the evolving body of scholarship that illustrate the growth of equity considerations in ORE: public perceptions, acceptance, attitudes, and conflict; public engagement in ORE-related decision-making processes; and justice and energy justice. Table 2 presents how equity considerations are distributed across these three stages.

4. Discussion

In our discussion below, we argue how the nexus between ORE and equity considerations has been conceptualized in previous studies, using three stages of perception-conflict-acceptance; public engagement as a catalyst for convergence; and energy justice. We build from this progress to discuss how current trends can shift toward an equitable ORE process by providing recommendations to address existing gaps and reduce inequities.

4.1. The initial stage: perception-conflict-acceptance

The importance of incorporating social science into ORE research has been highlighted due to stakeholder conflicts and the failure to achieve initial ORE project goals (Colton et al., 2016; Kularathna and Takagi, 2018). Between 2000 and 2012, researchers mainly focused on three interconnected concepts of public perception, conflicts, and public acceptance in a cause-and-effect relationship (Ellis et al., 2007; Firestone et al., 2009; Haggett, 2008). In this context, local opposition to ORE projects was attributed to a lack of shared ideas and values among stakeholders, resulting in low or no public acceptance (Park et al., 2022b). This relationship implicitly aligns with the concept of recognition justice, which underscores the importance of acknowledging and valuing diverse stakeholder perspectives. Recognition justice addresses "the process of disrespect, insult, and degradation that devalues some people and some places' identities in comparison to others" (Walker, 2009, p. 615).

Between 2009 and 2012, public perception became a key research focus and prompted researchers to analyze stakeholders' views on ORE. Research investigating public perceptions of ORE argued that public attitudes are rooted in general values and beliefs (Bidwell, 2013). Low and Altman (1992) mentioned place attachment as one of these values and described it as an emotional bond between individuals or groups and the familiar locations they inhabit. Devine-Wright (2009) expanded on this idea, framing place attachment as a form of place-protective action that arises when a new development proposal threatens pre-existing emotional attachment. Another key factor influencing local attitudes is the perceived fairness of development, which includes both processes and outcomes (Bidwell, 2013; Wolsink, 2007). Fairness in process refers to whether ORE projects are open and participatory or closed and institutional. Fairness in outcomes concerns about how benefits are distributed among different stakeholders (Bidwell, 2013; Walker and Devine-Wright, 2008).

The complexity of public perceptions, policy challenges, and varying attitudes toward ORE need to be managed to achieve public acceptance, prompting researchers to explore ways to reconcile or mitigate these differences. A key theme in this research is the need for approaches that address conflicts, particularly in responses to public concerns such as aesthetics, environmental impacts, and place attachment (Devine-Wright and Howes, 2010; Firestone et al., 2009; Haggett, 2008). Scholars also discussed the importance of building trust within local communities to mitigate opposition and increase support, as people's relationships with key actors strongly influence their attitudes

Table 2
Equity considerations across the ORE-equity nexus development stages. The equity considerations listed are keywords identified in the reviewed articles.

Development stages	Equity considerations	# of occurrences per year																
		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Perception-Conflict-Acceptance	Public acceptance	1	1	2	3	1	1	3	7	2	4	1	3	4	3	7	4	
	Attitudes			1	1	3	1	2	1	4	2	2	1	3	4	4	2	3
	Public perception								3	1	1	1	1	2	2	4	3	3
	Place attachment					1	1	1	2	2	1	1	1	1	3	1	1	1
	NIMBYism				1	2	1	1	3	1	1	1	1	1	1	1	1	1
	Conflicts					2	1	1	1	1	1	1	1	1	2	2	1	1
Public engagement	Fairness										1	1	1	2	4	4	4	4
	Engagement											1	1	2	2	2	2	2
	Fisheries											1	1	1	1	1	1	1
	Participation											1	1	1	2	2	1	1
	Trust											1	1	1	1	1	1	1
Justice and Energy Justice	Co-location												2					
	Indigenous community												1		1	1	1	1
	Aquaculture												1		1	1	1	1
	Co-existence												1		1	1	2	2
	Consultation												1		1	1	2	2
	Tourism												1		1	1	1	1
	Justice												1		1	1	1	1
	Recreation												1		1	1	1	1
	Energy justice												1		1	1	1	3

(Devine-Wright and Howes, 2010; Jones and Eiser, 2010). In addition, researchers emphasized the role of spatial planning, regulatory reforms, and improving public understanding of ORE's benefits in overcoming policy and political barriers (Firestone et al., 2009; O'Keeffe and Haggett, 2012). Moreover, balancing economic and ecological concerns is essential, particularly in marine and coastal contexts, where public support often depends on perceived local and environmental benefits (Bailey et al., 2011; Devine-Wright, 2011). Collectively, these studies emphasize the importance of integrating diverse research approaches to provide holistic insights into public perceptions and acceptance and to inform more policy and planning strategies (Ellis et al., 2007).

4.2. The second stage: public engagement as a catalyst for convergence

From the beginning of 2013, researchers focused on the importance of public engagement to converge different stakeholders' attitudes. Soma and Haggett (2015) referred to public engagement as involving impacted people before policy decisions, allowing them to express concerns and interests through open, transparent, and inclusive processes. Johnson et al. (2015) posed two key questions for achieving effective public engagement: Who are the stakeholders? and How are stakeholders engaged in ORE processes? Regarding the first question, articles applied different stakeholder characterization methods. Some researchers categorized stakeholders into those who use a system directly or indirectly and those who contribute to developing the system (Johnson et al., 2015). Others adopted the stakeholder salience model introduced by Mitchell et al. (1997), which characterizes key stakeholders based on three main attributes: power, the ability of one social actor to influence another's actions; urgency, the degree to which stakeholder claims require immediate attention due to time sensitivity and importance; and legitimacy, a generalized assumption that a stakeholder's actions are desirable, proper, or appropriate within a socially constructed system of norms and values. Based on these attributes, Mitchell et al. (1997) classify stakeholders into seven categories: dormant, discretionary, demanding, dangerous, dependent, dominant, and definitive.

The first category, dormant stakeholders, includes regulatory authorities, who may have high power but low public legitimacy and urgency. The second, discretionary stakeholders, such as environmental NGOs, have a higher level of legitimacy. The third, demanding stakeholders, possess high urgency but lack legitimacy and power. Grassroots organizations composed of local coastal residents fall into this group, as they are committed to preserving marine ecosystems but lack formal legitimacy or political influence. The fourth category, dominant stakeholders, includes energy developers and investors, who have high power and legitimacy but may or may not have high urgency, supported by their financial and technical resources. The fifth, dependent stakeholders, such as fishers, have high urgency and legitimacy but low power. The sixth, dangerous stakeholders, hold high power and urgency but low legitimacy. A key example is environmental activists, who can influence projects through protests, legal actions, or public campaigns. The final category, definitive stakeholders, includes Indigenous communities, who possess high power, legitimacy, and urgency.

To examine how stakeholders are engaged in the ORE process, Johnson et al. (2015) and Soma and Haggett (2015) analyzed different levels of stakeholder engagement, determining involvement levels based on the importance of each stakeholder category. The most basic level of engagement is awareness, which includes information provision and primarily aims to increase project legitimacy. A deeper level is consultation, where public feedback is incorporated into decision-making processes to gain insights into public opinion. The deepest level is involvement or empowerment, where stakeholders actively participate and contribute to decision-making processes (Johnson et al., 2015; Quiroz-Aitken et al., 2014; Reilly et al., 2016).

Reviewing public engagement as a solution for aligning different attitudes toward ORE, we identify three key challenges: prioritization,

perception, and process. Prioritization refers to the exclusion of certain stakeholders from the ORE planning process if they fall into the wrong category or are denied the deeper levels of engagement they deserve. For example, in a study on tidal power development in Maine, tribes were categorized as dominant stakeholders with legitimacy and power, yet their interests were not considered urgent, leading developers to limit their engagement to the basic level, merely informing them of project plans (Johnson et al., 2015). Perception highlights that many individuals are unaware of their rights and opportunities to participate in ORE planning. Soma and Haggett (2015) found that a significant number of local residents were unaware of consultation events to attend. In addition, in a tidal energy study, locals praised developers for keeping them "informed" regardless of whether they deserve to get "involved" and "empowered" during the process (Johnson et al., 2015). The third challenge, process, refers to the top-down nature of public engagement, which often lacks genuine participation and is perceived as a box-ticking exercise to meet legal requirements rather than address local concerns (Reilly et al., 2016; Soma and Haggett, 2015; Zhang et al., 2017). This lack of trust is further reinforced by low levels of transparency, accountability, and consensus in ORE processes (Soma and Haggett, 2015; Zhang et al., 2017). Effective engagement should not impose constructed local views but instead, provide a space where communities can express their perspectives in a well-framed manner (Rydin et al., 2018).

In recent studies, researchers refined stakeholder engagement in ORE processes. Reed et al. (2018) discussed participation through public participatory processes in which power dynamics, identification of stakeholders, participants' values, knowledge production methods, and knowledge types are well-defined and transparent. (Park et al., 2022b) suggested cooperative planning theory, highlighting the need for social dialogue on location, design, and operation methods within a dynamic process. While different approaches exist for developing public participation, the overarching goal remains to achieve public acceptance by identifying commonalities while respecting differences (Park et al., 2022b).

Overall, studies in this stage show that early, frequent, and transparent engagement fosters trust, reduces opposition, and increases local acceptance (Hall and Lazarus, 2015; Reilly et al., 2016). Researchers suggest that communication strategies should align with community values, whether emphasizing economic opportunities, environmental preservation, or cultural connections to place, to achieve public support (Brownlee et al., 2015; De Groot and Bailey, 2016). In particular, stakeholders such as fishers and coastal residents express the need for meaningful involvement in decision-making processes, and allow them to contribute to outcomes rather than serving as a mere formality (Chen et al., 2015; B. J. A. Walker et al., 2014). Additionally, researchers highlight the importance of nuanced engagement approaches, as socio-political and historical factors influence stakeholder attitudes. For instance, Indigenous communities are particularly concerned with recognition and procedural justice and long-term control over energy projects (Karlstrom & Ryghaug, 2014; Krupa et al., 2015). Thus, public engagement should extend beyond consultation to function as a tool for convergence— aligning the interests of developers, governments, and diverse community groups (Kerr et al., 2014; Walker et al., 2014).

4.3. The third stage: emerging energy justice in the ORE-equity nexus

In the third stage, energy justice emerged as a key concept within equity considerations in ORE research. Energy justice is defined as "a global energy system that fairly disseminates both the benefits and costs of energy services, and one that has representative and impartial energy decision-making" (Sovacool et al., 2017, p. 677). Initially, the energy justice framework was based on two core tenets: procedural justice and distributional justice (Fuller and Bulkeley, 2013). It later expanded to include recognition and cosmopolitan justice (Heffron and McCauley, 2017).

"Distribution justice focuses on the fairness of the distribution of harm, procedural justice is about the fairness of decision-making, and justice as recognition is related to prejudice and discrimination" (Williams and Doyon, 2020, p. 145). Restorative justice aims to repair the harm inflicted on affected people (Heffron and McCauley, 2017). Cosmopolitan justice emphasizes that we need to consider the cross-border effects of energy activities (Sokolowski and Heffron, 2022). Jenkins et al. (2016) argue that addressing injustice requires identifying concerns, affected groups, and strategies for remediation.

Regarding the main aspects of energy justice, Dwyer and Bidwell (2019) highlighted the role of procedural fairness in fostering trust, which in turn enhances public acceptance of ORE. They argued that while public acceptance is essential for a successful energy transition, achieving it remains challenging due to procedural deficiencies in public engagement processes, particularly concerning fairness and stakeholder trust. In contrast, Bacchiocchi et al. (2022) discussed that energy justice is not achieved solely through inclusive processes, as formal consultation processes often give more voice to lesser impacted communities and fail to meet the needs of local and Indigenous groups. They emphasized the importance of recognition justice and underscored acknowledging and incorporating unique cultural, spiritual, and environmental concerns from diverse stakeholders, including people of color, tribal and Indigenous populations, and low-income groups (Bacchiocchi et al., 2022; Healy and Barry, 2017). Tyler et al. (2022) emphasized distributional justice, arguing that community benefits, such as economic development, environmental improvements, and direct investments in local infrastructure, are crucial for rectifying perceived inequity in ORE projects. In a recent study, Withouck et al. (2023) examined three tenets of energy justice across various stages of offshore renewable energy projects, from strategic planning and pre-application phases to construction and operation. Their findings highlighted that while procedural justice has improved, other aspects of justice remain insufficiently addressed. Recognition justice continues to suffer from the underrepresentation of local groups, such as small-scale fishers, and the marginalization of their local knowledge. Distributional justice faces challenges in balancing short-term impacts with ambitious renewable energy targets, complicating efforts to achieve equitable compromises within local communities (Withouck et al., 2023). Furthermore, integrating restorative justice into policy frameworks remains difficult, as it requires a fundamental shift from traditional top-down approaches toward more collaborative and inclusive methods (Park et al., 2024).

Focusing on the main dimensions of justice—procedural, distributional, and recognitional—studies in this stage highlight several practical implications for ORE development. Procedural justice requires moving beyond formal consultation processes to foster trust through inclusive dialogue with affected communities. Dwyer and Bidwell (2019) showed this through informal engagement methods like "science-fair" style meetings and the use of impartial mediators. In addition, ORE decision-making should incorporate underrepresented voices, such as small fishing fleets, for fairer outcomes (Withouck et al., 2023).

Distributive justice focuses on the fair distribution of benefits and burdens. Ferguson et al. (2019) found that perceived local benefits, including job creation and improved infrastructure, are significant predictors of public support. Brannstrom et al. (2022) emphasized that transparent and equitable economic distribution reduces opposition, particularly in resource-dependent communities.

Recognition justice, as discussed by Bacchiocchi et al. (2022) and Hooper et al. (2020), emphasizes the need to acknowledge cultural and historical attachments to lands and seascapes. Paolinelli et al. (2022) and Stelmach et al. (2023) highlighted the importance of participatory design processes that integrate visual, cultural, and environmental concerns alongside economic factors. These studies collectively suggest that for truly equitable ORE development, developers and policymakers should prioritize trust-building, fair distribution of benefits and burdens, and the recognition of diverse cultural values within affected communities.

5. Concluding remarks and recommendations

Our findings illustrate that, firstly, a specific concept of equity remains largely absent from offshore renewable energy (ORE) research. Much of the existing research focuses on exploring the connection between ORE and equity considerations, ranging from early studies on public acceptance and perception to recent inquiries into energy justice. Although these equity considerations have addressed various social issues, the lack of a unified conceptualization of equity may lead to unjust narratives and discourses in equitable ORE development processes (Bacchiocchi et al., 2022).

Secondly, the ORE-equity nexus has received significant attention from ecological economists, as well as from policy and social perspectives. However, the planning perspective remains underrepresented contributing to less than ten percent of the discourse on this topic. At the same time, geographers and planners play a significant role in addressing equity issues within marine spatial planning (MSP) (Gilek et al., 2021), and there is broad consensus among planners regarding the social importance of marine areas (Jezak et al., 2019). This paradox raises a critical question: How can planners, who are often responsible for addressing social issues within MSP, take on a larger role in ensuring equitable processes within ORE?

Thirdly, the perception and prioritization of concerns surrounding ORE vary significantly across communities and places. In developed countries, primary concerns toward ORE include aesthetic impacts, harm to wildlife, and effects on recreation and large-scale fishing industries (Buchmayr et al., 2021; Firestone et al., 2009; Sokoloski et al., 2018). In contrast, in developing countries, where many residents depend on marine resources for their livelihoods, and in Indigenous communities with unique cultural values, concerns are more focused on the safety of small-scale fishing practices and basic local economic stability (Brannstrom et al., 2022; Zhang et al., 2017). In addition, developing countries face significant recognition justice challenges, which contribute to low public awareness and limited support for ORE projects, exacerbated by restricted access to project information (Ramachandran et al., 2020). In many cases, local elites often control information, serving as intermediaries between investors and marginalized communities, thereby reinforcing unequal participation in decision-making processes (Gorayeb et al., 2024). These diverse community priorities, shaped by distinct values, norms, and socioeconomic circumstances, underscore the need for future research to address the current oversight in distinguishing between these context-specific concerns within ORE development processes.

Finally, while discussions on justice have emerged across various disciplines, energy justice remains an evolving concept in ORE studies. Procedural justice has seen progress through approaches such as the public participatory process (Reed et al., 2018) or cooperative planning theory (Park et al., 2022b), yet recognitional and distributional justices remain insufficiently addressed (Withouck et al., 2023). This uneven progress reflects broader challenges in energy policymaking, where efforts to create inclusive processes often fail to address deeper systemic issues, such as power imbalances or historical inequities (Jenkins et al., 2016; Sovacool et al., 2017). As a result, many energy policy failures stem from the absence of a comprehensive energy justice framework that integrates distributive, procedural, recognitional, restorative, and cosmopolitan justice principles. Without this integrated framework, policies often fail to address structural deficiencies and lead to socio-economic disparities and increasing resistance to policy implementation (Heffron and Sokolowski, 2024). For instance, insufficient consideration of diverse stakeholder needs reflects a failure in recognition justice (Newell and Mulvaney, 2013). A lack of integration between social and technical dimensions shows weaknesses in procedural justice, where participatory processes remain superficial or inaccessible (Stirling, 2014). Furthermore, an inability to reconcile competing justice principles, such as prioritizing affordability at the expense of environmental sustainability, highlights a failure in distributive justice (Heffron

and McCauley, 2017). Moreover, trade-offs between energy justice principles pose further challenges, as achieving one goal of energy justice may inadvertently undermine another or create new injustices (Bacchiocchi et al., 2022). Addressing these challenges requires a justice-driven framework that not only recognizes policy failures but also provides mechanisms to balance competing priorities, engage diverse stakeholders, and embed justice considerations in decision-making (Sokolowski and Heffron, 2022).

To advance equitable ORE development, future research should focus on some key areas. First, it should explicitly define and incorporate the concept of equity and the many social science tools designed to address it, in order to design locally-appropriate ORE project goals, prevent unjust outcomes, and enhance understanding of public acceptance and perceptions. Second, it should explore how planners and planning practices, which play a critical role in marine spatial planning, can contribute to equitable ORE development processes. This includes a wide range of new approaches in the broader planning field that go beyond traditional marine spatial planning tools. Third, research should consider the diverse priorities of different communities and recognize their unique values, norms, and socio-economic conditions, ensuring that ORE development brings local benefits alongside global ones. Fourth, future research should aim to develop a flexible ORE process that integrates all energy justice principles and minimizes negative

trade-offs to ensure a more equitable and sustainable future for ORE and frontline coastal communities. Finally, future research should explore practical implementation strategies, such as leveraging legal and regulatory frameworks, which can serve as effective tools to enforce energy justice and promote equitable outcomes in ORE development.

CRediT authorship contribution statement

Mohammad Nasir Tighsazzadeh: Writing – original draft.
Andréanne Doyon: Writing – review & editing.
Shana Lee Hirsch: Writing – review & editing.
Andrés M. Cisneros-Montemayor: Writing – review & editing, Supervision.

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.

Acknowledgement

We gratefully acknowledge the support of the Nippon Foundation Ocean Nexus in facilitating this research.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ocgeoaman.2025.107603>.

Appendix 1

Table

List of selected peer-reviewed articles' journals and their subject areas.

Journal	Subject area and Impact Factor (IF)	Number of articles
Energy Research and Social Science	Energy (General), Social Sciences (General); IF: 6.7	11
Energy Policy	Political, Economic, Planning, Environmental and Social Aspects of Energy; IF: 9	11
Marine Policy	The principal social science disciplines relevant to the formulation of marine policy; IF: 3.8	10
Journal of Environmental Policy & Planning	Critical analysis of environmental policy and planning; IF: 3.2	4
Local Environment	sustainability planning, policy, and politics related to equity, justice, and the local environment; IF: 2.4	2
Journal of Environmental Planning and Management	Focusing on practical, technical, social, and political problems in the planning and management of the environment; IF: 3.9	2
Frontiers in Energy Research	Explores sustainable and environmental developments in energy; IF: 3.4	2
Estuaries and Coasts	estuarine and near coastal ecosystems; IF: 2.7	2
Marine and Coastal Fisheries	Ecosystem-based marine and coastal fisheries; IF: 2.2	1
Journal of Leisure Research	Interdisciplinary research on leisure's impact; IF: 3.2	1
Journal of Great Lakes Research	covering natural and social sciences related to great lakes; IF: 2.2	1
Journal of Environmental Management	Environmental Management: Research for sustainability and impact; 8.7	1
Journal of Cleaner Production	advancing research and practice in cleaner production, environmental, and sustainability; IF: 11.1	1
International Journal of Marine Energy	research and case studies related to marine renewable energy; IF: N/A	1
Environmental Impact Assessment Review	EIA Review: Impact assessment, theory, practice, innovation; IF: 7.9	1
Energy	energy analysis, modeling and prediction, integrated energy systems, energy planning, and energy management; IF: 9	1
Energies	Technology development, engineering policy, and management studies related to energy; IF: 3.2	1
Climate Policy	adaptation, mitigation, governance, policy design, economic and social aspects; IF: 7.1	1
Business Strategy and Development	Focusing on the private sector's role in sustainable development, inclusive business models, and ESG issues in developing country settings; IF: 2.8	1
Applied Economics	the application of economic analysis to specific problems in both the public and private sectors; IF: 2.2	1

Data availability

Data will be made available on request.

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