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Agreements and benefits in emerging ocean sectors: Are we moving towards an equitable Blue Economy?

Andrés M. Cisneros-Montemayor [a,*], Anna K. Ducros [b], Nathan J. Bennett [c,d,e], Leah M. Fusco [f], Margot Hessing-Lewis [g], Gerald G. Singh [c,f], Sarah C. Klain [h]

[a] Nippon Foundation Ocean Nexus Program, School of Resource and Environmental Policy, Simon Fraser University, Vancouver, Canada
[b] Marine Affairs Program, Dalhousie University, Halifax, NS, Canada
[c] Institute for the Oceans and Fisheries, University of British Columbia, Vancouver, BC, Canada
[d] The Peopled Seas Initiative, Vancouver, Canada
[e] People and the Ocean Specialist Group, Commission on Environmental, Economic and Social Policy, International Union for the Conservation of Nature, Switzerland
[f] Department of Geography, Memorial University, St. John's, NL, Canada
[g] Hakai Institute, Institute for the Oceans and Fisheries, University of British Columbia, Vancouver, BC, Canada
[h] Department of Environment and Society, Quinney College of Natural Resources, Utah State University, Logan, UT, USA

A B S T R A C T

Transitioning to a Blue Economy that prioritizes social equity will be challenging in ocean sectors but could be comparatively easier for newer industries where appropriate guidelines can be followed from the start. We focus here on two emerging ocean sectors—blue carbon and ocean energy—and an evaluation of benefit-sharing agreements at operational sites, and the recipients and types of these benefits. This is an initial yet useful gauge of progress towards integration of social equity concerns as envisioned under a Blue Economy. The number ($n = 84$) and scale of ocean energy sites is rapidly increasing but highly concentrated in a few regions. The ocean energy sector is currently focused on serving grids in urbanized areas and reducing national emissions, and economic benefit-sharing mechanisms with local residents are less common (35% of all sites). However, some cases show how local communities can be better included in the planning and implementation of ocean energy, including negotiation of subsequent economic benefits. Despite widespread interest in blue carbon, we found very few ($n = 4$) operational sites; nonetheless, these were deeply involved with and often led by local communities who are the main beneficiaries. Voluntary public and corporate social responsibility actions are useful, but government regulation must play an essential role in requiring equitable processes and supporting equitable outcomes, similar to now-standard environmental regulations to avoid negative impacts and increase the likelihood of ecological sustainability. Emerging ocean sectors have a unique opportunity to advance social equity and environmental sustainability within Blue Economies, but this will be much more easily achieved if equity guidelines are prioritized and mandated so that business-as-usual practices do not become entrenched.

1. Introduction

Private companies, nations, and intergovernmental institutions have expressed enormous interest in ocean resources as an engine for global economic growth. Ocean sectors are rapidly expanding in size and space (Jouffray et al., 2020), and recent estimates project up to US$22 trillion in increased profits from the ocean economy by 2050 (Konar and Ding, 2020). However, if this development intends to follow a Blue Economy approach—defined here as the establishment of ocean sectors that are equitable, sustainable, and viable (Bennett et al., 2019a,b; Cisneros-Montemayor et al., 2019)—the real challenge will not be in expanding existing industries but in ensuring that they adhere to this approach (Bennett et al., 2021; Cisneros-Montemayor et al., 2021). Increasingly, initiatives intended to advance human well-being are focused on reducing social and economic inequity rather than simply increasing profits (Bennett, 2018; Österblom et al., 2021), and concrete frameworks, methods, and guidelines have been proposed by scholars, governments, and development agencies to integrate procedural and distributional equity in decisions related to the oceans (e.g., Allison et al., 2020; Bennett, 2018; Cisneros-Montemayor et al., 2019; FAO, 2015). However, as explored in this study, the actual advancement of equitable outcomes in ocean industries remains unclear.

Promoting environmental sustainability has long been a basic component of any ocean development framework, but the explicit prioritization of equity goals is what differentiates a Blue Economy from other development approaches (Bennett et al., 2019a,b; Cisneros-Montemayor et al., 2019; Keen et al., 2017; UNDESA, 2014). Despite these efforts, inequities persist in long-established ocean sectors, such as

* Corresponding author.
E-mail address: a_cisneros@sfu.ca (A.M. Cisneros-Montemayor).

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fisheries (Finkbeiner et al., 2017) and mariculture (Campbell et al., 2021), and more recent ones like marine bioprospecting (Blasiak et al., 2018). Arguably, the current definition of sustainable development, as outlined by the UN Sustainable Development Agenda, is equity-centered, evident in its pledge that "no one will be left behind" (UN, 2015). One might therefore expect this to be reflected in the establishment of—at the very least—the newest ocean sectors, emerging after the recognition of the core importance of equity goals.

This study focuses specifically on the types of mechanisms (if any) for economic benefit-sharing applied at operational sites of two emerging ocean sectors in many Blue Economy plans: blue carbon and marine renewable energy (Cisneros-Montemayor et al., 2019). Both sectors are relatively recent—e.g., compared to fisheries, aquaculture, or ecotourism—yet rapidly growing and could contribute to long-term sustainability efforts through reduction or capture of greenhouse gas (GHG) emissions (see Methods for further background information). Blue carbon ecosystems include coastal vegetated systems (e.g., seagrass beds, mangroves, salt marshes) that provide carbon sequestration services (Macreadie et al., 2019). The emerging Blue Carbon (BC) sector refers to the protection or restoration of these habitats through management activities, and the potential of these activities to generate monetary gains through carbon offset markets (Thomas, 2014). Marine renewable energy (henceforth referred to here as "ocean energy," OE) refers to the generation of electricity from offshore wind, hydrokinetic energy (e.g., waves, tides and currents), thermal differences, salinity gradients and biomass (Borthwick, 2016; Zheng and Pan, 2014). Here we focus only on OE technologies that are operating commercially as of 2021: offshore wind and tidal installations.

Social equity refers to much wider issues of recognition, inclusion, and restorative justice, including for historically marginalized regions or peoples, and this should be a fundamental aspect of a Blue Economy (Allison et al., 2020; Bennett et al., 2019). As defined by Friedman et al. (2018), for example, social equity considers the "distribution of costs, responsibilities, rights, and benefits; the procedure by which decisions are made and who has a voice; recognition— acknowledgement of and respect for the equal status of distinct identities, histories, values, and interests; and context—the social, economic, and political history and circumstances." Our focus on benefit-sharing agreements and realized benefits here is only part of the picture, yet useful given that high-level policy plans often frame the social benefits of ocean investments in terms of increased employment and local economic benefits (e.g., Konar and Ding, 2020; UN-DESA, 2017). We discuss our results in the context of the potential of these industries to meet the social, economic, and ecological goals expressed in Blue Economy plans at regional and international scales.

2. Methods

2.1. Research scope: blue carbon and ocean energy

The objective of this study is to collect and analyze information regarding the existence and types of benefit-sharing agreements and observed benefits—as a useful proxy for social equity considerations—in operational blue carbon (BC) and ocean energy (OE) sites. As noted above, there is high interest in OE and BC both for their potential market profits and their contribution to environmental sustainability through emissions reductions, carbon capture, and ecosystem restoration. There are a range of additional direct benefits and ecosystem services from these sectors that must also be considered. For BC, these include provision of essential habitat for a range of valuable species and ecosystem services, including mitigation of extreme weather impacts and sea-level rise, protection from coastal erosion, and filtration of land-borne pathogens (Lamb et al., 2017; Locatelli et al., 2014). Similar co-benefits could arise from specific types of OE development, for example through multi-purpose installations that also provide habitat for wild or farmed marine species (Klain et al., 2020; Pelc and Fujita, 2002). However, this will require targeted (likely including government) investments to develop and test technologies with habitat benefits (Abhinav et al., 2020). These additional social and ecological benefits should be recognized and incorporated into future analyses using new quantitative and qualitative information specific to these rapidly growing technologies.

The global potential of harnessing offshore wind and tidal energy for electricity generation is vast but constrained by costs (e.g., siting, construction including connecting to adequately sized substation, maintenance), policies (e.g., the Jones Act in the US prohibits foreign construction vessels from operating from US ports, potentially increasing the cost of offshore wind construction), and citizen opposition (e.g., fishing industry and coastal property owners) (Firestone et al., 2012; Klain et al., 2017). Economies of scale and technical innovation towards ever larger turbines (e.g., the first offshore wind farm, Vinebay, had 35 m rotors in 1991 as compared to the 2020 Haliade-X prototype that has 220 m rotors, also see Shields et al., 2021) have led to a focus on large-scale offshore wind projects near existing grid infrastructure and high energy demand (Zheng and Pan, 2014). There have been proposals and pilot projects for more local approaches to OE to benefit remote and underserved areas (USDE, 2021), including for powering specific sites such as mariculture farms or desalination plants that will require a different development framework and could largely make use of existing technology (Li et al., 2018).

Conceptual interest in BC has grown over the past decade as data on carbon sequestration in coastal habitats has been quantified (Macreadie et al., 2019). The potential for carbon dioxide mitigation based on high carbon sequestration values (Kennedy et al., 2010) and a cosmopolitan distribution for key BC habitats, such as seagrass, mangroves and marsh, have been promising for the implementation of carbon financing for BC projects (Thomas, 2014). Recent global assessments of 'Natural Climate Solutions' and the CO_2 mitigation pathways associated with BC ecosystems provide guidance on research and policy needs to advance this sector (e.g., Macreadie et al., 2021). A barrier for BC initiatives around the world has been a lack of data regarding carbon sequestration rates specific to localized coastal vegetated systems, which may differ from global averages (e.g., Prentice et al., 2020). This is crucial information given that the basic requirements for carbon offsetting markets include a reasonably accurate estimate of how much carbon can be offset per area.

2.2. Literature review and analysis

Given the relatively recent emergence of these sectors and the still limited number of operational sites, we first compiled a full list of these sites based on public information (as of July 2021). While there are many more proposed initiatives and various broader sectoral development plans, we focus here only on commercial operational sites to allow for exploring observed processes and outcomes related to equitable benefits before, during, and after implementation. An initial review identified a total of 142 sites and focused on determining if sites remain operational and screening for inclusion in further analysis. This initial review found that many sites (9 and over 40 for BC and OE, respectively) are pilot or proof-of-concept initiatives, still in the planning and construction stages, or have been decommissioned.

Selected sites were further investigated through a systematic online review of available published literature, including peer-reviewed literature, media reports, and public company and government evaluation reports that provided data on benefit-sharing agreements and received or perceived benefits. The search was done on Google and Google Scholar. Site names alongside keywords such as "benefits," "social," "equity," "sharing mechanisms," "agreement," and "consultation" were used to gather information. For each case, we followed links, references and relevant topics and terms that pertained to distributional equity. To confirm findings and/or find missing information, we contacted site representatives through email to find appropriate references. The full list of included sites and references is provided in Table S1.

A Blue Economy must ideally comprise a comprehensive set of social, cultural, and material processes and outcomes (Allison et al., 2020; Bennett et al., 2019a,b, 2021; Cisneros-Montemayor et al., 2019); however, it was not possible for us to evaluate these deeper considerations with currently available data (which is itself a notable result). While supporting such research is essential for long-term equity and sustainability of ocean sectors, here we focus on a narrow evaluation of the existence of benefit-sharing mechanisms among funders, developers, and/or local residents, as well as the types and recipients of such benefits. More specifically, we focused on compiling available information on the following (Table S2):

- *When* benefits occur: During planning (e.g., inclusion in education and capacity-building efforts for future participation), implementation (e.g., construction employment, restitution for disruption), operational stage (e.g., ongoing benefits such as direct payments or energy discounts).
- *Who* receives benefits: Which stakeholder groups benefit at different stages of projects?
- *What* benefits occur: What types of benefits were/are received? For example, employment, ownership stakes, contribution to a community fund, education and apprenticeships, share of profits, lower energy costs, spatial access privileges, tax incentives, indirect benefits (e.g., via supply chains or tourist facilities).

We additionally considered how benefits were granted (i.e., mechanisms) and their context (for example, if they followed legal mandates or voluntary commitments), but there was not sufficient information to incorporate this into our results.

3. Results

There are many proposed initiatives and an extensive literature on ocean energy (including offshore wind and tidal energy) and blue carbon (including mangrove, salt marsh, and seagrass systems) around the world, yet a much more limited number of operational sites (i.e., commercially operating OE projects and BC projects actively selling carbon sequestration services in carbon markets). Based on our review, we identified 84 OE (78 offshore wind, 6 tidal) and 4 BCE sites within 19 countries (Fig. 1). Notably, all operational OE sites in our data were in the northern hemisphere, with the vast majority in Northern Europe (95% of total capacity), followed by Eastern Asia (4%). While there were fewer total BC sites, all but one were in the southern hemisphere (Fig. 1). Note that because of the significant difference in total number of operational sites, overall patterns in the results largely reflect OE and thus results by sector are specified throughout the results section and figures below.

Trends in global OE capacity (as reflected by peak potential in gigawatts, GW) support a clear growing interest in OE as a central component of the future ocean economy (Fig. 2A). With the exception of the tidal power station at La Rance, France—the first to be established in 1966 and still the second-largest in the world—OE projects before the year 2000 were small, with a mean capacity of 5.4 GW. Since the year 2000, the mean capacity of operational OE sites in our data is 206 GW (SD = 173 GW). Interestingly, yearly added capacity has a declining trend (Fig. 2B) driven by a slight decrease in the number of new operational sites since the mid-2010s (due to a mix of politics, regulatory hurdles, and technology costs, *author's pers. obs.*). Regarding BC, most discussion in the literature has focused on mangrove systems, and these represent two of the sites (in Kenya and Indonesia); the others are sited on estuarine marshland. While all four sites feature plans for carbon-based financing, are engaged in advanced baseline research and restoration activities, and have identified target carbon markets, to our knowledge only one site (Mikoko Pamoja, in Kenya) currently receives income primarily from estimation and subsequent sales of sequestered carbon.

Specific information on benefit-sharing mechanisms was difficult to find, which is itself a notable result given that the benefits and agreements we specifically focused on here are in principle much easier to integrate and quantify in development and implementation plans (compared to other aspects of equity). Available information suggests that 31 out of 88 (35%) sites specifically involved economic benefit-sharing mechanisms (Fig. 2B; Table S2). These mechanisms primarily included agreements to provide energy discounts to local residents, directly fund local infrastructure improvements, and set up community benefit funds contributed to by energy companies (Table S2).

Available literature for 64 cases noted information regarding the effects of BC and OE projects on stakeholder groups (including the

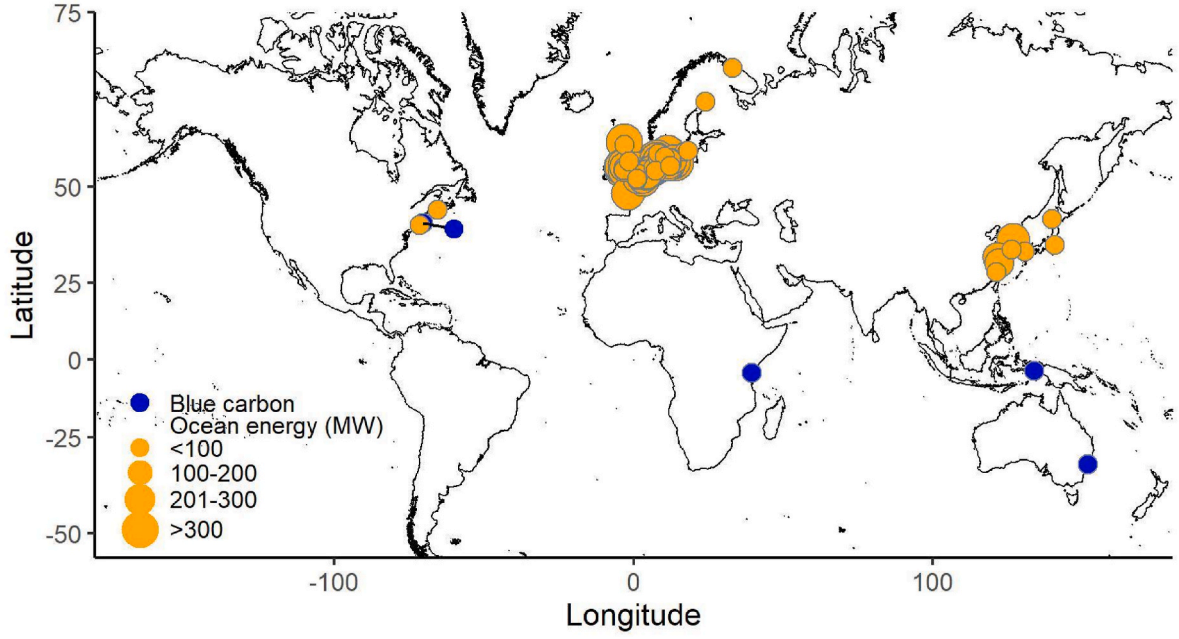

Fig. 1. Current operational blue carbon and ocean energy (offshore wind, tidal energy) sites based on references in Table S1. Available information on scale (megawatts, MW) is shown for ocean energy sites.

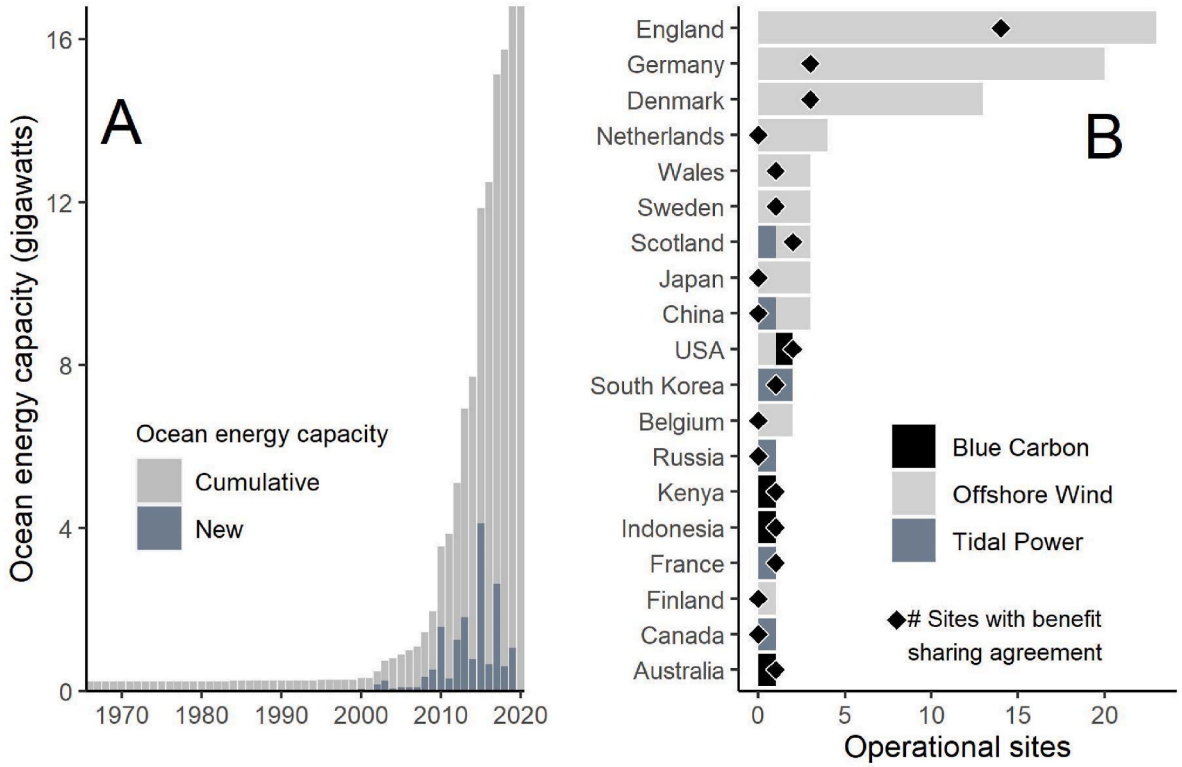

Fig. 2. **A)** New and cumulative ocean energy capacity (including wind and tidal) in sites with available information (see Table S1 for references). **B)** Operational blue carbon, offshore wind, and tidal energy sites by country, and total sites where information was found to indicate existing mechanisms for sharing economic benefits.

marine ecosystem itself), including positive (82%), negative (15%), and mixed effects (3%) (Table S2). The groups most often noted to have experienced positive effects were users of clean energy (38%, almost always noted as the number of household equivalents the projects can power), local communities (19%), and governments (10%) (Fig. 3). While mentions of negative effects were less frequent, the stakeholder groups experiencing the most negative effects from projects were the marine ecosystem (85% of mentions) and fishers (75% negative and 25% mixed), with additional mentions of negative or mixed effects for local tourism and communities (Fig. 3).

Based on available data (Table S2), most of the effects on stakeholders (Fig. 3) occurred during the operation stage of OE (Fig. 4) whereas negative or mixed impacts were noted during the implementation stages, with the exception of negative effects on marine ecosystems (Fig. 4). In addition to the benefits of providing clean energy and reducing emissions, community development funds created by developers were named as some of the key benefits to local communities from these projects. We did not find information related to local benefits (or impacts) during the planning stage of projects. As some older sites approach their intended lifespan it will be useful for future research to additionally consider the 'decommission' stage of projects; however, we did not find enough examples to include this in our analysis at this time.

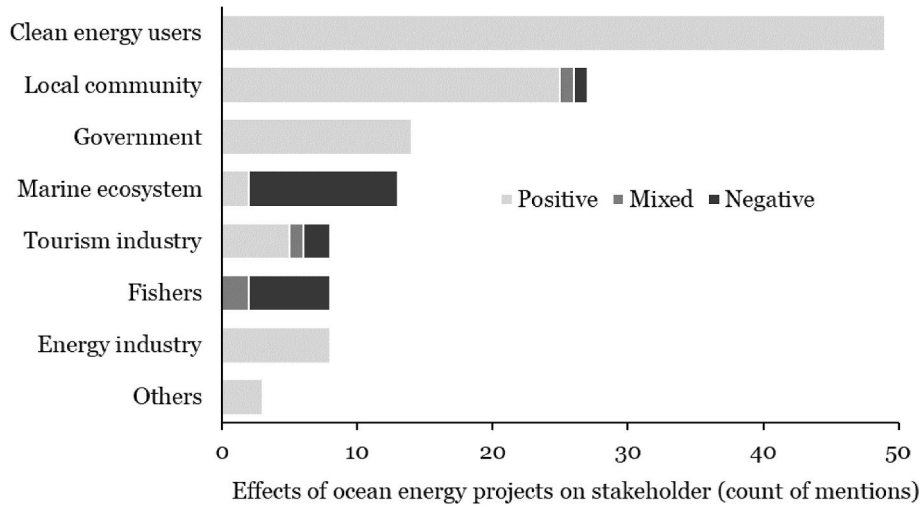

Fig. 3. Mentions of positive (light grey), negative (black), or mixed (dark grey) effects from ocean energy sites on stakeholders, as noted in case studies with available information (Table S2).

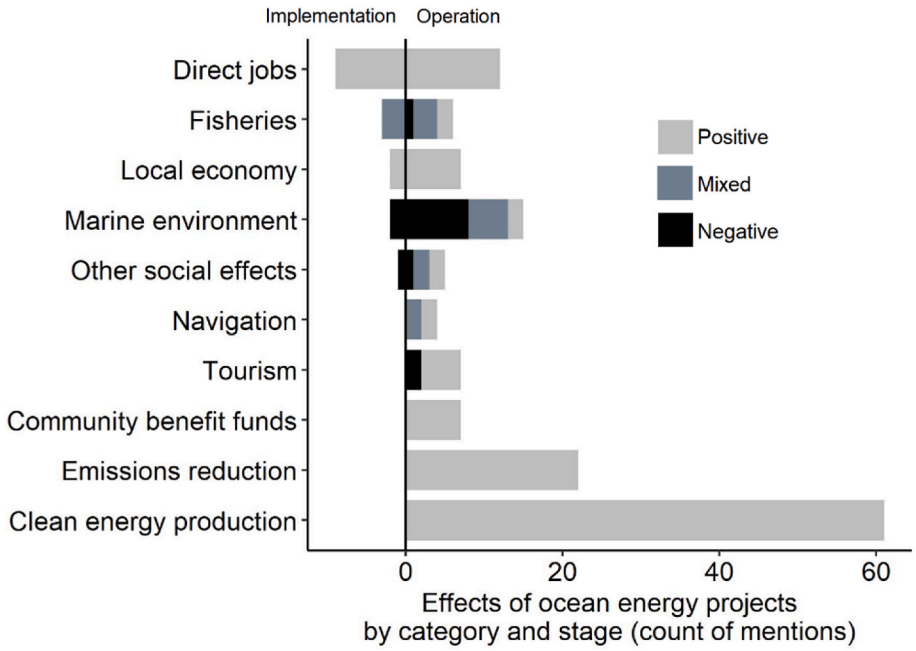

Fig. 4. Mentions of positive (light grey), mixed (grey), and negative (black) impacts at the implementation and operation stages, by type of effect, for ocean energy (OE) cases with available information (Table S2). No information was found related to benefits (or impacts) during the planning stage of projects.

4. Discussion

A focus on social equity—including prioritization of local economic benefits—is a distinguishing aspect of the Blue Economy framework for ocean development (Bennett et al., 2019; Cisneros-Montemayor et al., 2019, 2021). The challenges of this transformational aspect of a Blue Economy for very large and well-established ocean sectors, such as fisheries or marine tourism, have already been recognized (Campbell et al., 2021; Cisneros-Montemayor et al., 2019; Cohen et al., 2019). This is perhaps one of the factors contributing to wider interest in the potential for emerging ocean sectors to follow Blue Economy guidelines as they establish and expand (UN-DESA, 2017). And yet, perhaps following from more traditional ocean development narratives (Voyer et al., 2018), much of the attention on BC and OE currently focuses on aspects of economic viability, ecological sustainability, and technological innovation (UN-DESA, 2017) rather than distributional equity *per se*.

Though we focus narrowly on direct effects from OE and BC sites (Fig. 1), the results of this study indicate that more actions need to be immediately taken to ensure that emerging ocean sectors indeed become a model for the integration of social equity in ocean economies (Fig. 2B). For OE specifically, which is expanding more rapidly (primarily offshore wind farms) (Fig. 2A), available information suggests that only a third of operational sites included local residents in their implementation processes, and almost always in the form of project updates and consultation sessions. The rate of overall and individual growth of OE projects (Fig. 2A) is important to consider because larger operations—and the significant space, financing, and national-level policies they involve—can make it more difficult to meaningfully involve local communities or user groups specifically in planning. To achieve Blue Economy objectives, regional and national policies and planning processes require greater consideration of equity across differing scales of benefits and impacts from ocean sectors. Benefits, for example in the form of emissions reductions or clean energy production (which consumers overwhelmingly use together and undistinguished from other sources of energy), tend to be broad and high-level while negative impacts, for example through loss of fishing opportunities or local habitat, are much more acute and regionally-specific (Figs. 3 and 4). The use of OE for smaller and more specific community projects has been proposed as an alternative development pathway (Cisneros-Montemayor et al., 2019), but available information shows this is not its current trajectory (Fig. 2A). Given the amount of public subsidies for large OE developments (Fig. 1), however, it would seem feasible for governments to similarly subsidize smaller OE ventures to provide energy in rural coastal areas.

For OE sites, mechanisms for local inclusion mainly included various forms of information sharing and consultation sessions with residents and representatives of key sectors (e.g., trade associations, fishing industry, governments) (Klain et al., 2017; Rudolph et al., 2018). These projects benefit a wide array of stakeholders, including energy users, but also local economies and communities during operations and implementation (Fig. 3). The most direct form of local community benefits (aside from the wider benefits of clean energy production) were community benefit funds created by developers and administered by local governments (Fig. 4). Local employment is an important benefit but mainly occurs during construction (Table S2) and is not guaranteed, especially when projects are very large. In the UK, there was mention of prioritizing local contractors to perform planning (e.g., surveying and environmental impact assessments) and construction activities, which would certainly contribute to local economies during the implementation stage. Despite positive effects of projects on local communities, it is also clear that fishers as a specific user group have been consistently negatively impacted by OE projects (Fig. 3), both through loss of access to space (Table S2) and through negative impacts on the marine ecosystem (Fig. 3) more widely. This is perhaps unsurprising given the historical and ongoing marginalization of many fishers from Blue Economy policies (Cisneros-Montemayor et al., 2019), the negative perceptions and impacts of overfishing, and the current focus on emerging rather than traditional sectors for future ocean economies (Konar and Ding, 2020). However, it is clearly an inequitable outcome that must be mitigated, including through financial reparations and better consultation on project siting.

There are examples of procedural justice initiatives during the implementation and operations of OE projects, for example as part of the Block Island Wind Farm in the USA (Dwyer and Bidwell, 2019; Klain et al., 2017). Following from negotiations with local communities, the developer paid to couple broadband internet with the underwater electrical cable connecting the wind project, island, and mainland, as well as partnered with a community college to provide training and

educational opportunities for locals to become offshore wind technicians and project managers. A second example is developers signing a Community Benefits Agreement (CBA) with Vineyard Power, a local energy cooperative, and creating a Resiliency and Affordability Fund to support the development of battery storage solar projects in the host communities on Martha's Vineyard and Cape Cod. It is important to note that community benefits do not necessarily need to be directly tied to ocean developments. For example, in the UK, as part of the Lynn & Inner Dowsing offshore wind farm development, the company donated funds for central heating and hot water to be installed at a local community center. Of course, long-term outcomes and ongoing support for community benefits (e.g., continued contribution to funds, maintenance or upgrading of infrastructure) will have to be monitored as more projects include similar agreements.

Private sector, academic and policy literature have identified BC as a key future sector in Blue Economies (Pendleton et al., 2012); however, there are currently few demonstrated projects (Fig. 1). One of the main barriers to implementing BC as a self-sustaining economic activity includes quantifying carbon sequestration amounts and rates to follow standards necessary for participation in carbon markets (Thomas, 2014; Macreadie et al., 2021). This can change as more research quantifies carbon sequestration across a range of latitudes and coastlines so that sites can at least partially rely on existing information, but there must be ongoing support for these efforts to anticipate and inform future technical questions (Macreadie et al., 2019). Importantly, research on environmental themes must also be complemented with parallel work to establish clear guidance (or regulations) regarding the sharing of benefits when projects do become operational. One potential opportunity in this regard is that, due to the same complexities and uncertainties associated with the ecology of mangroves, saltmarshes, and seagrasses, BC projects tend to be small in scale. This can facilitate cooperative management and community-led initiatives, where impacts (or lack thereof) are easier to conceptualize and validate (Gordon et al., 2011) compared to benefits for global climate.

A fundamental potential inequity that must be highlighted here is the fact that most carbon markets that would finance BC projects are located in highly developed regions, while BC projects themselves are mainly in developing ones (Fig. 1). This transfer from wealthy industries to local communities can be a part of climate justice initiatives; however, the fact that BC specifically relies on formal area delimitation and protection poses risks of displacement from space and access to resources that must be addressed in any Blue Economy project (Bennett et al., 2021; Campero et al., 2022). Apart from the expected but still limited market-based approach for financing BC projects (Thomas, 2014), financing by governments or philanthropy can allow for initiating projects (NGOs were primary partners in the BC cases in our results; Table S1) but is likely not financially self-sustaining unless they involve a transition to tenure rights for local communities. In this regard, the local benefits of restoring and protecting coastal vegetated systems could clearly go beyond BC and include fisheries, ecotourism, and other ocean sectors (Vierros, 2017). In the case of Mikoko Pamoja, the most formal established BC site, yearly revenue from sales of sequestered carbon is divided by and among community members, with an additional portion pooled towards joint community benefits such as water access and medical equipment (MPCO, 2018). These wider benefits that do not directly rely on increased local ecosystem services from habitat protection and restoration may be key for future projects, particularly given the complexity of local ecosystem dynamics (Macreadie et al., 2019).

As discussed above, benefits agreements between governments, communities, and companies may include a guarantee of local hiring for construction jobs, local procurement of goods or services, payment of revenues to local governments or the public, or funding for skills training and social programs (Table S2). Voluntary commitments by institutions and the private sector have made prominent statements in this regard, but on-the-ground actions have focused overwhelmingly on building capacity and very little on public participation in planning and co-management (Voyer, 2021). Importantly in the context of a Blue Economy, promoting more equitable processes and outcomes cannot therefore be voluntary and requires clear regulations and legal recognition for local communities' tenure over marine spaces regardless of the type of ocean sector being considered (Barbesgaard, 2018). Furthermore, existing structures of inequity mean that efforts must be made to ensure that "community" benefits are evenly experienced among different racial, ethnic, gender, and socio-economic groups within a population (Ferguson, 2021). For example, companies proposing to produce oil in offshore Newfoundland (NL), Canada, must have a benefits plan approved that includes local work commitments. In the agreement for the most recent offshore drilling project, the companies involved agreed to construct all structures in NL (rather than shipping them from elsewhere) (Hebron, 2018). However, jobs in construction in NL predominantly go to men (Statistics Canada, 2021); the project's 2018 benefits report noted that of 1152 jobs, 92% were filled by people in the province, yet 84% of management and engineering jobs on the project were filled by men, while 75% of administrative positions were filled by women (Hebron, 2018). Further analysis and attention to intersectionalities are clearly needed to ensure that any benefits agreement requirements or equity considerations take account of everyone in the community and to prioritize ownership and leadership positions by historically marginalized groups.

A Blue Economy approach specifically focused on redressing inequities clearly requires explicit consideration, integration, and monitoring of distributional (and, of course, procedural) equity (Bennett et al., 2019a,b; Cisneros-Montemayor et al., 2019). Drawing from our results and the discussion above, overarching recommendations include, first, for governments and international (and national) financial institutions to require transparent 'equity impact assessments' for any proposed ocean development initiative and the free, prior, and informed consent of impacted communities before projects are approved. These must not be 'box-ticking' exercises but should rather be informed by social science and practitioners on best practices for equity, diversity, and inclusion, and backed-up by legal and not only voluntary frameworks. A second and linked action is to require a prioritization of local employment and participation in leadership (potentially including initial capacity-building) across gender, ethnic, and other social groups. Emerging ocean sectors in particular could thus help break down inequitable power and benefit dynamics that may be more entrenched in other industries. Finally, there must be more public funding, support, and guidance for natural and social science research to inform local initiatives and communities of potential costs and benefits, thus mitigating potential conflicts when research and information are primarily provided by private companies.

5. Concluding remarks

Despite welcome advances towards a Blue Economy or at least more sustainable ocean economies (Konar and Ding, 2020), being nominally sustainable and increasing access to technology and information does not guarantee that local communities and individuals will benefit from or embrace new sectors, and the opposite could indeed be true (Singh et al., 2021a,b). Changing ocean economies—including establishing new ocean sectors—will have to contend with local traditions, needs, and preferences regarding existing uses of ocean and coastal space (Klain et al., 2017; Wylie et al., 2016) and existing governance and institutional frameworks (Singh et al., 2021a,b). Expansion of these sectors will produce many similar social, economic, and ecological issues to those surrounding the establishment of marine protected areas, where questions regarding decision-making processes and social impacts have been discussed for decades (Agardy, 2000; Caveen et al., 2013). Yet, ocean sectors continue to rapidly expand and surmount operational challenges (Jouffray et al., 2020), at the same time as they consolidate under a limited number of transnational companies (Virdin

et al., 2021) that may or may not take voluntary actions to share benefits and avoid harms. It can be very difficult to ensure that benefits are equitable in sectors where a few large players have high economic and political power and relying on voluntary actions from private industry can contribute to this power imbalance. Therefore, clear regulations must be in place to promote equitable processes and outcomes before problematic power dynamics become entrenched (Bennett et al., 2019a, b; Haas et al., 2016).

Policies and regulations related to addressing the needs of coastal communities and advancing social equity through ocean development are lagging far behind technological and market progress (Bennett et al., 2021; Danielsen et al., 2013), as reflected in our results. If future oceans are to contribute more widely to human well-being, as expressed in global goals (UN, 2015; https://www.oceandecade.org), it is imperative to establish guidelines and clear regulations to support social equity and community-led projects as an explicit component of new ocean sectors, even as we transform established ones.

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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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ocecoaman.2022.106097.

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:References

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