Policy Brief 2026

HARVESTING TIDES AND WAVES

Energy Autonomy and Resilient Coastal Communities

www.uib.no/bsrs
Global Challenges at UiB, Bergen, Norway

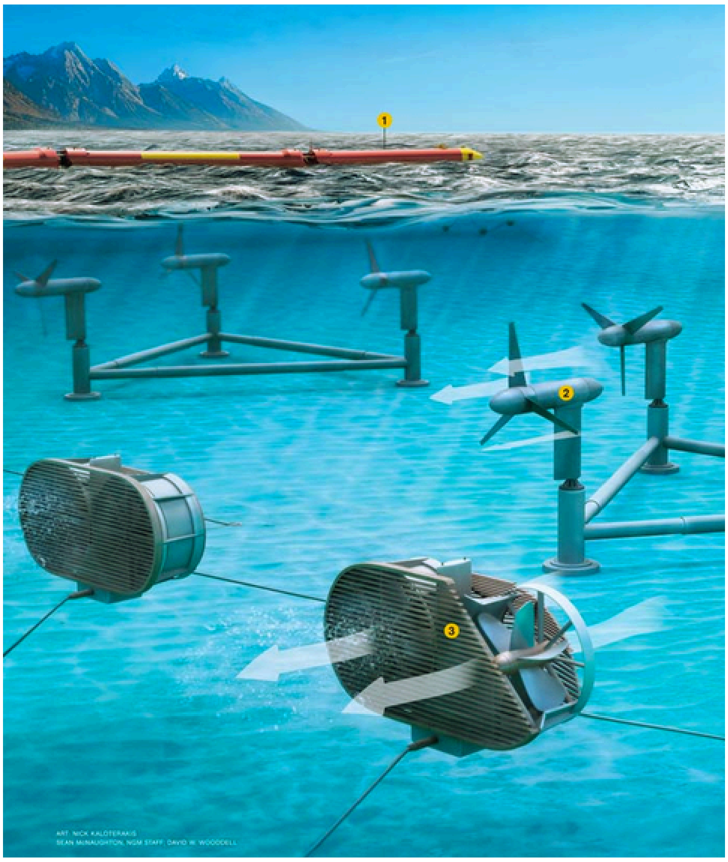
BERGEN SUMMER RESEARCH SCHOOL
GLOBAL CHALLENGES

Key points

1. Wave and tidal energy can support energy autonomy in coastal and insular communities strengthening local energy security.
2. Small-scale wave and tidal energy has minor environmental impacts, with a potential increase in biomass that can benefit fisheries.
3. Wave and tidal energy projects must recognise small-scale communities as co-designers and beneficiaries.

Introduction

Tidal and wave power are renewable energy sources with the potential to contribute 10% of our global energy demand[3]. Unlike solar and wind, tidal energy is highly predictable, while wave energy can complement renewable energy sources in hybrid systems, contributing to a reduction in fossil fuel use, stabilising microgrids, and powering local blue-economy infrastructure. The technologies available for these types of energy are still developing, but there are successful operations such as the MeyGen array in northern Scotland that supplies energy to 6000 homes[4]. While this array has four large turbines, tidal power can be utilised at a smaller and less expensive scale to supply power to small-scale coastal communities. One such example is in Shetland where a small community owns the three rural North Yell tidal turbines that each power the energy



Devices generating wave and tidal energy. Source: Ref 1

equivalent of thirty homes, one local ice plant, and contribute to local industries' energy consumption5. While there is an overall positive attitude towards using tidal energy at a small scale, there remains limited implementation, and technology could be improved to increase efficiency and ease of use. We are therefore proposing to invest in tidal energy as a means to improve autonomy and energy security of small scale and isolated coastal communities.

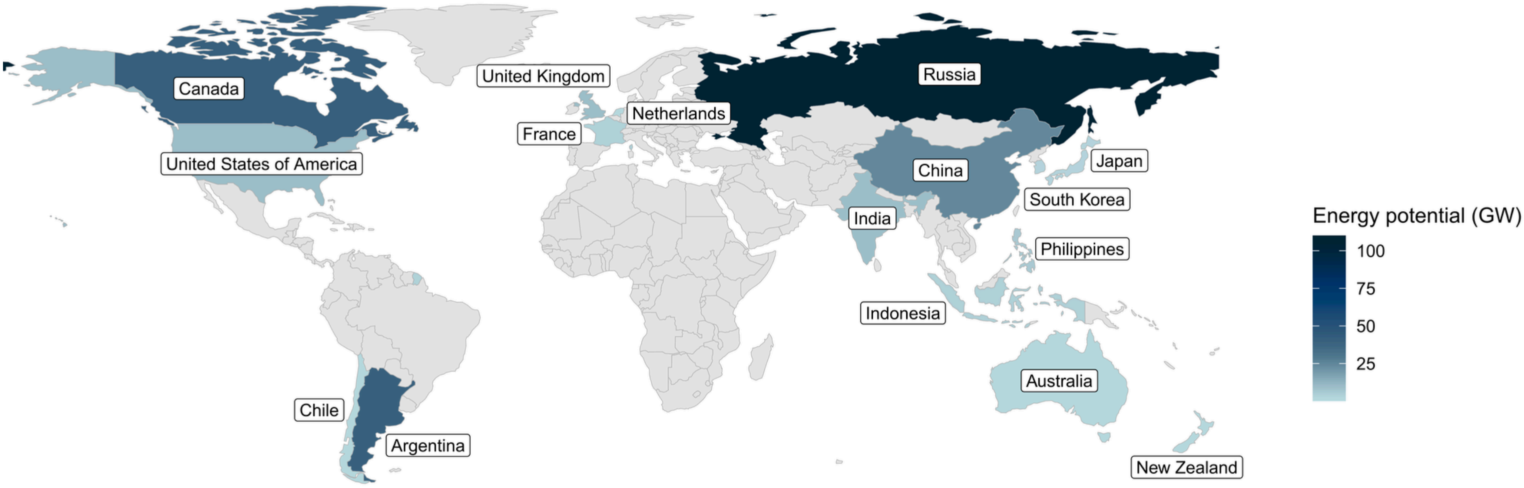
Environmental Analysis

Marine renewable energy installations such as tidal turbines and wave-energy devices can contribute substantially to climate-change mitigation by providing low-carbon electricity, but they may also affect marine ecosystems. Potential risks include collision of diving birds, fish, and marine mammals with turbines, underwater noise disturbance, habitat alteration through changes to seabed structure and water flow, and possible effects of degrading infrastructure and electromagnetic fields from subsea cables on sensitive species such as rays and sharks. However, these developments may also create ecological opportunities by providing artificial reef habitat for marine organisms, reducing fishing pressure through restricted-access zones, and potentially increasing local biodiversity and biomass. The overall environmental outcome depends on the design, scale, and location of the development, highlighting the importance of careful site selection, environmental monitoring, and adaptive management[6,7]. The physical impacts include changes in sea level, but in the large arrays this is on the order of cm, so would be negligible for a small-scale device. Also the residence and flushing time of the water would be impacted which could lead to changes in biogeochemical cycles such as nutrient distribution. These would be considerations that vary with site, and having a small scale array would limit these impacts to the environment[8].

Ownership, Accountability, and Economic Resilience

Small-scale insular and coastal communities often face structural challenges linked to geographic isolation, weak grid connectivity, dependence on imported fuels, high energy costs, limited infrastructure, and political or economic marginalisation. In this context, wave and tidal energy can contribute to energy autonomy and resilience, but only if planned in relation to the social and livelihood systems that already sustain these communities.

Many coastal and insular communities are centred around small-scale fisheries (SSF) and their supporting activities. Beyond their economic relevance, SSF are intertwined with food security and sovereignty, employment, cultural heritage, intergenerational continuity, ecological knowledge, and plural ways of living with the sea. They provide a substantial share of global catches, support the livelihoods, and sustainably feed and nourish the growing population.



Map showing global wave and tidal energy potential. Data from Ref 2

Yet, the sector remains often underrepresented in decision-making and increasingly pressured by other blue-economy sectors, including tourism, aquaculture, offshore energy, and industrial fishing.

Wave and tidal energy plans must therefore engage with procedural, distributional and recognitional justice from the onset of planning. This means adapting energy development to coastal landscapes. Foregrounding this tripartite justice allows marine energy to strengthen small-scale fisheries if it is designed around livelihood needs rather than only around energy production. Amongst others, locally generated wave and tidal electricity could support harbour electrification, cold storage and transport, desalination, digital monitoring systems, and eventually charging infrastructure for electric or hybrid vessels.

The key policy principle is therefore that wave and tidal energy should not simply be installed near fishing communities, but infrastructurally tied to them. The long-term success of tidal energy projects depends thus not only on technological performance but also on how benefits are distributed within coastal communities. One challenge is that tidal energy projects require substantial upfront investment and are often financed by governments, utilities, or external investors[9]. While such funding is necessary, there is a risk that economic returns leave the community while local residents bear potential environmental and social impacts. Community-based ownership models, cooperative investment structures, and local revenue-sharing mechanisms can help address this imbalance and ensure distributional justice for the coastal communities[10]. These approaches allow a portion of project revenues to be reinvested into local priorities such as fisheries infrastructure, community services, coastal adaptation measures, and workforce development.

Economic resilience should also be considered alongside energy generation. Reliable locally produced electricity can support activities that are critical for coastal livelihoods, including fish processing, cold storage, small businesses, and transportation services. Reducing dependence on imported fuels may improve energy affordability and strenghten the ability of communities to withstand future economic or environmental shocks[11].

To ensure that promised benefits are delivered, simple accountability mechanisms should accompany project implementation. Rather than evaluating projects solely on electricity production, policymakers and communities should monitor a broader set of outcomes. Indicators such as reductions in diesel consumption, local employment creation, community participation, and the proportion of project revenues retained locally can provide a clearer picture of whether tidal energy is contributing to both climate mitigation and local development[12]. And communicating these evaluations to the public can strengthen trust and make sure the project remains aligned with community priorities, while minimizing unintended impacts on their economic foundations and local marine ecosystems. By linking renewable energy development with local economic resilience, tidal energy can become a tool not only for decarbonisation but also for strengthening coastal communities.

Recommendations

- Tidal and wave energy is an emerging form of energy that has the potential to increase energy autonomy among small scale coastal communities.
- Wave and tidal energy at small-scale has minimal negative impacts on the environment, but sites should be chosen with consideration to the environment and how these areas could promote increase in biomass and fisheries sustainability.
- A just transition and energy development means inclusion of small scale coastal communities from the beginning, making sure that it is not only installed near coastal communities, but infrastructurally tied to them and their livelihoods.

Authors
Alma Andersen Tjalve
Alli Lane
Terhemba Ambe-Uva
Manare Caroline Sejeng
Junu Jahana
Gabriel Araújo Njaim
Nadja Meister

Acknowledgements
We thank the University of Bergen, *Bergen Summer Research School: Ocean Expectations* for bringing us together as a group of interdisciplinary problem solvers to tackle super wicked global problems.

References
1. National Geographic Society. Tidal Energy. (2024).
2. Wani, F., Dong, J. & Polinder, H. Tidal Turbine Generators. in Advances in Modelling and Control of Wind and Hydrogenerators (ed. Ebrahimi, A.) (IntechOpen, 2020). doi:10.5772/intechopen.90433.
3. Haddout, S. et al. Advancements in Ocean Energy: Harnessing Tidal Currents and Wave Dynamics for a Sustainable Future. in A Green Vision Towards a Renewable Energy Future (ed. Oncel, S. S.) 73–87 (Springer Nature Switzerland, Cham, 2025). doi:10.1007/978-3-031-93926-6_3.
4. MeyGen - the best tidal stream site in the world. Ampeak Energy https://ampeak.energy/tidal-stream/meygen/.
5. Community Tidal Energy Is World First. Shetland.org https://www.shetland.org/blog/tidal-energy (2014).
6. Frid, C. et al. The environmental interactions of tidal and wave energy generation devices. Environ. Impact Assess. Rev. 32, 133–139 (2012).
7. Bonar, P. A. J., Bryden, I. G. & Borthwick, A. G. L. Social and ecological impacts of marine energy development. Renew. Sustain. Energy Rev. 47, 486–495 (2015).
8. Neill, S. P., Haas, K. A., Thiébot, J. & Yang, Z. A review of tidal energy—Resource, feedbacks, and environmental interactions. J. Renew. Sustain. Energy 13, 062702 (2021).
9. Kenresearch. Global Tidal Power Market | 2019 – 2030 | Ken Research. https://www.kenresearch.com/global-tidal-power-market.
10. Proimakis, N., Tara, H. & Østergaard, P. A. The role of small-scale and community-based projects in future development of the marine energy sector. Int. J. Sustain. Energy Plan. Manag. 155-166 Pages (2021) doi:10.5278/IJSEPM.6657.
11. Pan, A., Xu, S. & Zaidi, S. A. H. Environmental impact of energy imports: Natural resources income and natural gas production profitability in the Asia-Pacific Economic Cooperation Countries. Geosci. Front. 15, 101756 (2024).
12. Kaestner, L. Harnessing Tidal Energy In Developing Countries. THRIVE Project https://thrivabilitymatters.org/harnessing-tidal-energy-in-developing-countries/ (2023).