

Supplementary Information

Methodological note

The study area is the Spanish sea space composed of five subdivisions according to the Spanish Maritime Spatial Plan (*Planes de Ordenación del Espacio Marítimo* – POEM; BOE-A-2023-5704)¹.

POEM Subdivisions	Area in km ² (%)
Canary Islands (CAN)	536776 (47.6)
Straight y Alborán (ESAL)	25200.3 (2.2)
Levantine-Balearic (LEBA)	231547 (20.5)
North-Atlantic (NOR)	320221 (28.4)
South-Atlantic (SUR)	14299.4 (1.3)
TOTAL	1128043.7 (100%)

Supplementary Table 1. Overview of datasets collected and information resources for the construction of the geospatial layer.

OT/indicators	Sources of Information	Source
AI-penetration [EC net contribution in euro]	The CORDIS project database was used to search Blue Economy projects that have machine learning, deep learning or in more general artificial intelligence applications in their project summary. The search was restricted to project partners (coordinators, partners, associated partners). Sectors of the Blue Economy considered are marine renewable energy, shipping, maritime or marine spatial planning, fishery, aquaculture, deep sea mining, artificial reefs and DTO (Digital Twin Ocean). The string applied is as follows: <code>contenttype='project' AND frameworkProgramme='HORIZON' AND relatedRegion/region/euCode='ES' AND ('fishery' OR 'aquaculture' OR 'deep sea mining' OR 'floating offshore wind' OR 'port' OR 'ship' OR 'vessel' OR 'maritime spatial planning' OR 'marine spatial planning' OR 'Digital Twin Ocean' OR 'DTO' OR 'artificial reef') AND ('artificial intelligence' OR 'AI-based' OR 'AI methods' OR 'machine learning')</code> The results were exported in xlsx format and verified. Project not clearly referring to a Blue Economy sector and not including the word 'artificial intelligence' OR 'AI-based' OR 'AI methods' OR 'machine learning' were removed from the database.	• https://cordis.europa.eu/ • https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/eu-missions-horizon-europe/restore-our-ocean-and-waters/european-digital-twin-ocean-european-dto_en • https://ec.europa.eu/commission/presscorner/detail/en/SPEECH_24_981
Landing hubs & digitalization [nr. of digital landing hubs]	Digital landing hubs in the Spanish sea space: • <i>Medloop</i> (1360 km; Owner: SIPARTECH Sarl) subsea cable connecting Barcelona(ES)-Marseille(FR)-Genova(IT) • <i>Grace Hopper</i> (7191 km) subsea cable connecting New York (US)-Bilbao(ES)-Bude (UK). • <i>2Africa</i> subsea cable (45000 km; Owner: Bayobab, China Mobile, Meta, Orange, Saudi Telecom, Telecom Egypt, Vodafone, WIOCC) and includes a landing hub in Gran Canarias (ES). • <i>Anjana</i> (7121 km; Owner: Meta) subsea cable connects Santander (ES)-Oregon (US). • <i>Marea</i> (6605 km; Owner: Meta, Microsoft, Telxius) connecting Bilbao (ES) – Myrtle Beach (US).	• https://www.submarinecablemap.com/ • https://altios.com/spain/2022/12/07/spain-the-strategic-location-for-the-connection-of-submarine-cables/ • https://emodnet.ec.europa.eu/geoviewer/
Ferry Vessel electrification [nr. of vessels]	Cases of electrified vessels where web-searched and included two vessels of the Balearia recently activated. • <i>Rusadir</i> ferry operates within Malaga-Melilla route. • <i>Cap de Barbaria</i> is the first electric ferry in Spain for passengers for cargo with zero pollutant emission during port approaches and stays. The ferry operates in the route Ibiza-Formentera. In Barcelona port the • <i>Castalia</i> electric harbour workboat operates since 2023. In the Port of Barcelona, the Grimaldi Group has committed to preparing its ships to connect to shore power when the land-based infrastructure is ready. • <i>Ciudad de Palma de Tramed GLE</i>, which operates daily on the Barcelona - Palma de Mallorca route, will be the first ship used for the pilot. • <i>Bahia Zero</i> is a solar energy propelled electric catamaran touring in Santander Bay.	• https://www.oceanclaner.es/oc-tech-11m/ • https://www.alnasur.com/ • https://www.antena3.com/noticias/ciencia/aspiradora-basura-mar-made-galicia_202104136075cd9b361d780001055189.html • https://www.ecoembes.com/es/proyectos-medioambientales/upcycling-oceans • https://www.offshore-energy.biz/balearia-adds-electric-powered-ferry-rusadir-to-its-owned-fleet/ • https://www.balearia.com/en/cap-de-barbaria-ferry-

		elctrico • https://www.offshore-energy.biz/balearia-adds-electric-powered-ferry-rusadir-to-its-owned-fleet/; • https://www.offshore-energy.biz/balearias-2nd-lng-powered-fast-ferry-hits-the-water/; • https://www.bairdmaritime.com/work-boat-world/other-workboats/vessel-review-castalia-electric-harbour-workboat-for-spains-consulmar/; • https://piernext.portdebarcelona.cat/en/environment/ports-connect-ships-to-the-electricity-grid-to-avoid-pollution/; • https://www.alsa.es/barco-bahia-santander • http://en.syrennis.com/information/47-models-waste-collector-boats • https://en.beach-trotters.com/products/category/cleaning-boats • ¹ https://www.ecoembes.com/es/proyectos-medioambientales/upcycling-oceans
Marine Renewable Energy [sq km of suitable sea space]	<i>Floating Offshore Wind Energy</i>: the location of high potential areas for offshore wind energy development in Spain were retrieved from MITECO. <i>Wave Energy Converters (WEC)</i>: The dataset was retrieved from EMODNet Ocean Energy facilities – Project Sites. <i>High potential areas for Research-Development-Innovation</i>: The testing areas for different types of marine energy prototypes. The data was retrieved from MITECO. <i>RENMARINAS Demos Program</i>: The project is an investment programme for the testing and scale up of marine energy technology across different areas in Spain.	• https://www.miteco.gob.es/es/cartografia-y-sig/ide/descargas/costas-medio-marino/poem.html • https://commission.europa.eu/projects/renmarinas-demos-program_en • https://commission.europa.eu/projects/renmarinas-demos-program_en • https://emodnet.ec.europa.eu/geoviewer/
Port OPS [nr. of OPS]	Onshore Power Supplies (OPS) were collected and mapped from the Spanish OPS Master Plan.	• https://poweratberth.eu/?page_id=40&lang=es
ROV [nr. of studies]	Development and application of artificial reefs were collected through literature review and web search. This includes keep.eu portal (3D PARE Project- Optimized artificial reefs will be shaped through a large-scale 3Dprinting and low-impact and bio-receptive materials) and nature-inclusive designs for gravity anchors within the INFINITY Horizon Europe Programme).	<i>Illa-López, et al., 2023²; Mecho, A. et al. 2020³; Vigo, et al. 2023⁴; Ayma, A. et al. 2016⁵; Quelle, et al. 2011⁶; Lousada, et al. 2021⁷.</i>
Hydrogen installations [MW produced]	Datasets were derived from the Hydrogen Infrastructure Map. Showcasing concrete European hydrogen infrastructure projects and possibilities for transport routes and corridors. Fig1B manuscript represents the H2 production infrastructure in coastal territories.	• https://www.h2inframap.eu/
Fishery [Low or High penetration based on fishing vessel route density]	Low (L) or High (H) penetration based on yearly fishing vessel route per sq. km (EMODnet dataset 2023). The literature review represents the overall ambition of España Digital aid plan for the fishery sector. The overall aim is the digitalization of the fisheries and aquaculture sector, with lines of support for the fishing fleet, with the following lines of support: • Aid for the Spanish fishing fleet of vessels of less than 12 m for devices for the	• https://espanadigital.gob.es/en/lines-action/digitalization-fisheries-sector • https://cordis.europa.eu/project/id/869342

and aquaculture [nr. of infrastructure]	electronic submission of catches and for their geolocation. (ii) Aid for the Spanish fishing fleet of vessels over 24 m for the installation of a remote monitoring system for fisheries and the fight against discards. (iii) Aid for actions to digitize the fisheries and aquaculture sector. • Creation of a catch registration system, as well as a remote monitoring system, reinforcement of the Spanish Fisheries Information System (Sistema de Información Pesquero Español). • Aid for technological development and innovation in the fisheries and aquaculture sector • Actions for the modernization of the Network of Marine Reserves of Fishing Interest, including the implementation of digital technologies to enable the control and monitoring of the activities carried out in the reserve.	• Ricci et al., 2022⁸ • https://emodnet.ec.europa.eu/geoviewer/
Artificial reef effect [nr. of artificial reefs] nature positive solutions [MPA extension percentage]	In the Spanish Atlantic Area (Cantabria Region) 3D printed artificial reefs based on geopolymer and CEM III-cementitious binders (3DPARE Project - Artificial Reef printing for the Atlantic Area) aim at improving biomass colonization and mechanical properties. In Galicia, green Artificial Reefs were tested in the Ares Betanzos estuary (Galicia) and Ría de Vigo and Ría de Ferrol in NW Iberian coast. In the Mediterranean, in Cap de Creus, gorgonian restoration through artificial reefs is tested and multifunctional artificial reefs were installed to protect coastlines from erosion were installed in Malaga. Extending marine protected areas are an efficient planning measure to protect from climate change. The Spanish Maritime Spatial Plan foresees to extend existing Priority Use Areas (PUA)-Biodiversity within the High Potential Areas (HPA)-Biodiversity. The net percentage of MPA extension was used as proxy to represent the potential for NbS.	• https://www.ecoembes.com/es/proyectos-medioambientales/upcycling-oceans • http://en.syrennis.com/information/47-models-waste-collector-boats • https://en.beach-trotters.com/products/category/cleaning-boats • https://www.oceanclaner.es/oc-tech-11m/ • https://www.miteco.gob.es/es/cartografia-y-sig/ide/descargas/costas-medio-marino/poem.html
Ocean Clean-up systems [nr. of vessels]	Ocean clean up systems were collected using literature and web search. This included examples of marine litter clean-up vessels and the Ecoembes Initiative involving local fishing fleet. • Syrennis waste collector boats applied e.g. in Barcelona port • Beach-Trotters (Tarragona) • Oceanclaner (Gulf of Cadiz) • Alnasur (Port of Malaga) • El Nautilus (La Coruna) clean up robot • Other initiatives include Ecoembes involving 640 fishing fleets in 45 Spanish ports for marine litter collection across in Spain.	• http://en.syrennis.com/information/47-models-waste-collector-boats • https://en.beach-trotters.com/products/category/cleaning-boats • https://www.oceanclaner.es/oc-tech-11m/ • https://www.alnasur.com/ • https://www.antena3.com/noticias/ciencia/aspiradora-basura-mar-made-galicia_202104136075cd9b361d780001055189.html • https://www.ecoembes.com/es/proyectos-medioambientales/upcycling-oceans • https://en.beach-trotters.com/products/category/cleaning-boats
Mineral Resources [sq. km of potential resources]	The dataset represents the marine minerals that are energy-critical according to the marine geological atlas of the IGME (Instituto Geológico y Minero de España). This includes Co-rich FerroManganese Crusts, Phosphorites, polymetallic Nodules and Rock, pegmatite or vein hosted. The datasets were collected from EMODnet and were treated using geospatial tools.	• https://digital.csic.es/bitstream/10261/288938/1/marine_geological_atlas_2022.pdf • https://emodnet.ec.europa.eu/geoviewer/

References

1. BOE-A-2023-5704 Real Decreto 150/2023, de 28 de febrero, por el que se aprueban los planes de ordenación del espacio marítimo de las cinco demarcaciones marinas españolas.
https://www.boe.es/diario_boe/txt.php?id=BOE-A-2023-5704.
2. Illa-López, L., Cabrito, A., de Juan, S., Maynou, F. & Demestre, M. Distribution of rhodolith beds and their functional biodiversity characterisation using ROV images in the western Mediterranean Sea. *Science of The Total Environment* **905**, 167270 (2023).
3. Mecho, A. *et al.* Deep-sea litter in the Gulf of Cadiz (Northeastern Atlantic, Spain). *Marine Pollution Bulletin* **153**, 110969 (2020).
4. Vigo, M. *et al.* ROV-based monitoring of passive ecological recovery in a deep-sea no-take fishery reserve. *Science of The Total Environment* **883**, 163339 (2023).
5. Ayma, A. *et al.* Comparison between ROV video and Agassiz trawl methods for sampling deep water fauna of submarine canyons in the Northwestern Mediterranean Sea with observations on behavioural reactions of target species. *Deep Sea Research Part I: Oceanographic Research Papers* **114**, 149–159 (2016).
6. Quelle, C. *et al.* Chemometric tools to evaluate the spatial distribution of trace metals in surface sediments of two Spanish rías. *Talanta* **87**, 197–209 (2011).
7. Lousada, S. A. N. *et al.* Underwater Technical Inspections Using ROV Applied to Maritime and Coastal Engineering: The Study Case of Canary Islands. in *Underwater Work* (IntechOpen, 2021). doi:10.5772/intechopen.95599.
8. Ricci, P. *et al.* Benefits and Risks of the Technological Creep of LED Light Technologies Applied to the Purse Seine Fishery. *Biology* **11**, 48 (2022).