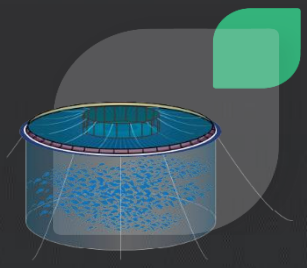
OCEAN CLEANTECH

MARKET INTEL WEBINAR SERIES

GERMANY



WEBINAR TEXT

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This is the script used in the webinar titled 'Ocean Cleantech: Market Intel Webinar Series – Germany' published on July 6, 2023. The webinar can be accessed here.

Here in Atlantic Canada, we are on the leading edge in ocean cleantech, specifically when it comes to environmental sensing, monitoring, and characterization technologies. Our businesses and research institutions are experts at using laser, sonar, radar, satellite, environmental DNA, and other technologies to understand our impact on the environment, operating in harsh and dynamic conditions, and climate change's impact on our industries and communities.

Atlantic Canada's capabilities are world class, but in order for the region to maintain its competitive standing it must continue to look outwards. We know that small and medium-sized enterprises (or SMEs) and institutions that engage more on the international stage tend to be more productive and more innovative.

We are Thinkwell Research and Strategy, and in this webinar series, we are exploring other jurisdictions in the world with strong clusters of ocean cleantech activities with capabilities analogous to our own.

We hope this series provides you with new market intelligence and ideas on where you can partner and collaborate on projects and innovations. At the end of the webinar, we will provide you with some information on the various funding mechanisms that exist which can help you move your ideas forward.

In this installment, we're looking at **Germany's** position as a world leader in marine research, looking at its various clusters and networks, organizations and institutions leading research and development, and technologies utilized from a cleantech perspective.

The German marine industry is heavily driven by foreign trade and is one of the country's most important sectors. Industries such as high-tech shipbuilding, high performance ports and logistics, and marine engineering are among the country's main marine focuses, as is marine research and training facilities.

The German government has developed the Maritime Agenda 2025, while places significant focus on continuing to build capacity and support these sectors. One of the Agenda's primary goals is to work with the business community to develop key priorities for applied research and funding programs, to increase the innovation capacity of SMEs, in effort to maintain Germany's current technology leadership, while also tapping into new marine markets.

Through clusters and networks, as well as collaborative efforts between and among various organizations, academia, and research institutions, several advancements in marine technology have been made to support key marine sectors in Germany.

[Clusters and networks]

Clusters and networks play a major role in ocean technology innovation and research, and often bring together various organizations, academia and research institutions to pool resources and combine expertise. Through clusters and networks, several major advancements in ocean technology have been made to support key marine sectors in Germany.

Of note, we will review **three major clusters and networks** throughout the country, including the Maritime Cluster Northern Germany, the German Marine Research Alliance, and The Ocean Floor – Earth's Uncharted Interface: Cluster of Excellence.

Maritime Cluster Northern Germany was created in 2011, and spans five northern regions of the country, including Bremen, Hamburg, Lower Saxony, Mecklenburg-Western Pomerania, and Schleswig-Holstein. The cluster focuses on increasing and enhancing collaboration within the marine sector, through developing national and international partnerships.

The cluster includes over 350 members across several marine industries, including shipbuilding, ship suppliers, marine engineering, and the offshore industry. The cluster assists its members by searching for innovation partners, advising on current and upcoming incentives and grants, and through arranging contacts in the maritime sector.

The Cluster has developed several key specialist groups, including maritime economy and offshore wind, innovation management, maritime information and communication technologies, maritime law, maritime safety and security, information, ship efficiency, and subsea communications.

Currently, the cluster is involved in several green innovation groups and projects, one of which is the GreenOffshoreTech project. This project includes 15 partners from across seven European countries and strives to develop a framework for cross-sectoral and international cooperation between SMEs, clusters, and regions as a whole. A main project objective is to increase opportunities for the development of innovative products and services, in effort to align with global climate initiatives furthering a resource-efficient blue economy.

The German Marine Research Alliance was formed in 2019, in collaboration with federal government and several northern German states. The focus of the Alliance is to connect academic and non-academic institutions who are conducting marine research with other strategic partners. Key focuses of the Alliance include research, coordination of infrastructure, knowledge transfer, and data management and digitalization with a marine sustainability lens.

Currently, the Alliance connects over 20 member institutions, including the Alfred Wegener Institute, Geomar, and the Max Planck Institute for Marine Microbiology.

The Alliance conducts several research missions, one of which focuses on Marine Carbon Sinks. This mission includes over 20 project partners from various research and academic groups and institutions throughout Germany. Within this mission, there are six collaborative projects investigating the role and extent to which the ocean is absorbing and storing carbon dioxide from the atmosphere. As well, the mission is studying the broader and larger scale impacts of carbon sinks on the marine environment, and earth systems overall. The project began in 2021 and is due to conclude in 2024.

Another research mission currently ongoing is the Protection and Sustainable Use of the Oceans (sustainMARE) project. This research mission includes over 20 project partners from various research and academic institutions throughout Germany. The objective of this research mission is to analyze and classify the use and pressures on marine spaces, and is intended to inform decision-making within politics, the economy and government. Through this project, the Alliance is fulfilling its mandate to develop science-based decision-

making options for sustainable management of the coasts, seas, and oceans. The project began in 2021 and is expected to finish in 2024.

An upcoming project which the Alliance will be undertaking is Pathways to Improved Risk Management in the Field of Marine Extreme Events and Natural Hazard. This research will focus on the interactions between extreme events and natural hazards, both on a short-term and long-term scale, and will consider impacts on both marine ecosystems, as well as coastal communities and livelihoods. The main objectives of the research mission are to improve the predictive capacity for marine extreme events and natural hazards, and support the sustainable development of coastal communities, thereby strengthening their resiliency. The work will involve political stakeholders in the implementation of powerful observation and early warning systems to allow for monitoring, assessment and response for extreme events and natural hazards. The work will also inform other opportunities for adaptation, prevention, protection, and risk management. This project is expected to begin in 2024.

The Ocean Floor – Earth's Uncharted Interface – Cluster of Excellence is hosted by MARUM Research Faculty at the University of Bremen. The Cluster was established in 2019, and brings together several leading research partners, including the Alfred Wegener Institute, Max Planck Institute, the University of Oldenburg, Constructor University, Senckenberg, and the Leibniz Centre for Tropical Marine Research. The cluster brings together various skills and expertise from partner institutions to increase potential for ocean floor research.

The cluster has six main research objectives, including to understand processes that transform the properties of biogenic particles on their transit to the ocean floor whilst under changing climatic conditions, to quantify the fluxes of carbon and other elements on the ocean floor, to develop an in-depth understanding of how the structure of the ocean floor ecosystems are related with biogeochemical processes and environmental conditions, to derive scenarios for 'warmer worlds' through comprehensive research from previous warm climate conditions recorded within ocean floor archives, to design and implement novel methods and technology for ocean floor observation, ultra-sensitive chemical analyses, and develop an earth-system modeling framework including ocean floor dynamics, and finally, to provide unbiased knowledge and information on ocean floor processes, to engage the public and also guide decision-making with respect to environmental protection and sustainable ocean use.

In terms of marine technology, the Cluster is looking to continue developing smart and innovative solutions for both observation and monitoring as well as sampling within extreme environmental conditions, and has availed of tools such as robotics, new sensors, and advanced digital solutions. Within the Cluster, the Enabler Deep-Sea Technology and Ocean Floor Observing Systems are striving to improve upon MARUM's existing ocean technology, and also develop new technologies and instrumentation tools specific to the cluster's research objectives.

Of note, in 2022, the Cluster deployed an autonomous underwater vehicle named IMGAM AUV, which was specifically developed for high resolution mapping and sampling of gas seeps. The AUV monitors and measures climate-damaging carbon dioxide and methane gas seeps.

[Key organizations and research groups within Germany]

The Ocean Technology Campus is based in Rostock, Germany. Its main objectives are to strengthen Germany's marine technology sector, by getting into important markets and pushing for sustainable and knowledge-based use of the oceans.

Of note, the Campus was recognized in 2021 by German Government as a ***future cluster*** within the "Clusters4Future" competition, through its innovative work with research, business, and society. Within the future cluster's field of Subsea Mobility and Autonomy, Digital Mission, Ocean Lense, Sustainable Ocean Use and Ocean Open Innovation, the cluster is to work on various research projects over the next few years.

Within the Campus's "basecamp", there are several key partners, including:

- ISC Training and Assembly (occupational safety and emergencies),
- Kraken Power (manufactures and distributes pressure-neutral drive-power supply and control technology for underwater robots),
- Fraunhofer Smart Ocean Technologies (an interdisciplinary research group developing marine technologies),
- Forschungs-verbund Mecklenburg-Vorpommern (program and project management),
- University of Rah-stock,
- Baltic Diver Germany (Taucherei-und Bergungs-betrieb Rostock) (a maritime service provider ranging from engineering to offshore operations services),
- Framework Robotics (marine technologies developed by a team of marine engineers),
- **AFZ Rostock** (Aus-und Fortbildungs- zentrum) (training and education programs and development),
- Stascheid (systems development, geophysics, and engineering geophysics services),
- Rah-stock Business (a business support company),
- Leibniz Institute for Baltic Sea Research (a non-university research institution focused on interdisciplinary marine research).

Digital Ocean Lab:
The Ocean Technology Campus's Digital Ocean Lab is operated by the Fraunhofer Institute for Computer Graphics Research and is an artificial reef. In the past, it has been used for fisheries research, however, it has become a unique testing field for new marine technology – and is noted to be the first test site in the world to be as close to land (roughly 1.5 kilometres from shore). The Site has broadband connection and power supply, enabling users to test their technologies within the platform.

The Campus devotes considerable research to further developing ocean technologies, specifically within the Subsea Mobility and Autonomy field. Of note, ***OTC-Base*** is a new project which will enable new innovative developments in the subsea sector to be quickly tested and further integrated into systems which already exist.

Another research project currently underway by the Campus is the ***OTC-FlyingArgo project.*** This project is developing an autonomous open-source underwater glider, which will further increase spatial and temporal resolution in oceanographic observation systems and processes. The project includes the development of a "passive-flapping-foil" glide concept and will feature an intelligent navigation and control system.

The Alfred Wegener Institute, created in 1980, has several sites across Germany. Its main areas of research include ocean acidification, sea ice, permafrost, marine litter, the North Sea, the Arctic Ocean, polar prediction, and ice sheets.

The Institute is comprised of biosciences, geosciences, and climate sciences research divisions, which all have their own respective research fields. The Biosciences research division conducts work in ecological chemistry, polar biological oceanography, coastal ecology, marine biogeosciences, integrative ecophysiology, functional ecology, and benthopelagic processes. The Geosciences division focuses on geophysics, glaciology, marine geochemistry, marine geology, polar terrestrial environmental systems, and permafrost research. The Climate Sciences division focuses on atmospheric physics, sea ice physics, climate dynamics, paleoclimate dynamic, and physical oceanography.

The Institute's high-performance infrastructure is critical to measuring and analyzing climate data, and utilizes several technologies such as their AUV PAUL, Ocean Floor Observing System (OFOS), ROVs, BioOptical Platform, AWI Winch System SWIPS, FRAM Moorings, Acoustic recorders, and Ice Mass balance Buoy.

GEOMAR Hemholtz Centre for Ocean Research Kiel is one of the world's leading institutions for ocean research. The Centre has four main research divisions, including Ocean Circulation and Climate Dynamics, Marine Geochemistry, Marine Ecology, and Dynamics of the Ocean Floor. Within these divisions, GEOMAR focuses on three core research themes: Ocean and Climate, Marine Ecosystems and Biogeochemical Cycles, and Ocean Threats and Benefits. GEOMAR has over 1,000 employees, of which 500 are scientists. There are 2 main campuses in Germany.

Of relevance, GEOMAR's DeepSea Monitoring Working Group is a multidisciplinary group of scientists, experts in geochemistry, geophysics, as well as software engineers and data scientists. Research focuses include monitoring methane gas flows on the sea floor, seafloor habitat mapping, and overall environmental monitoring. To conduct this research, the working group uses tools such as hydroacoustic (single beam and multibeam systems as well as sub-bottom profilers), electromagnetic (magnetometers), and optical (camera, fluorometers, lasers) technologies, in conjunction with processing techniques (such as 4D reconstruction, photogrammetry, statistical methods) and geochemical methods (through various laboratory analyses).

The Group also collaborates on a national and international scale for a variety of projects. Currently, they are involved in ProBaNNt, which is a project focused on transforming decision making processes during explosive ordnance disposal – this project is focused on conducting comprehensive assessments and is also further supported by artificial intelligence.

Additionally, GEOMAR's DeepSea Monitoring Working Group is also collaborating on a project titled MarDATA, in partnership with the Helmholtz School for Marine Data Science and its Centre for Polar and Marine Research, as well as the Alfred Wegener Institute. The project aims to develop a new group of "marine data scientists" through embedding researchers from computer science and mathematics into ocean sciences, covering various topics including supercomputing and modelling, bio-informatics, robotics, statistics, and big data.

The Max Planck Institute for Marine Microbiology was created in 1992. Its main research focuses are microorganisms in the ocean and other bodies of water. The Institute includes several departments and

working groups, and of particular interest, include a Microsensor Group, and a Joint Research Group for Deep-Sea Ecology and Technology.

To conduct its research, the Institute uses a number of technologies, including:

- A ***Microprofiler,*** which sits on the seafloor to measure and monitor the ocean's geochemistry. It is a non-invasive tool and does not take water or floor samples.

- ***Benthic Chambers,*** which sit at the interface between the ocean floor and measures exchange rates (of a variety of elements and substances, from oxygen to nutrients) between the floor and water column.

- ***Tramper, an autonomous crawler vehicle***, which is a remote-controlled vehicle meant for deep-sea exploration. The vehicles are intended for long-term observation and measurements, and have the ability to be operated for up to a year without needing maintenance.

- ***Lance-A-Lot,*** a benthic observatory which operates autonomously, and can conduct a series of complex tasks. It was developed to gain insight into the relationships between water currents, sediment transport, and benthic exchange processes.

- ***PumpCTD*** is a tool which was developed by the Institute. This tool is a Conductivity, Temperature, and Depth probe which can pump up to 2.5 litres of water per minute, from depths of up to 300 metres to a vessel's deck.

MARUM Research Facility is based at the University of Bremen. The facility's primary research focuses include Ocean and Climate, Geosphere and Biosphere interactions, and Seafloor Dynamics.

It is one of the few institutions in the world that possess highly advanced submersible vehicles and systems which can access the deep-sea ocean floor, obtain samples, and conduct experiments there. The institute uses a variety of technologies, such as the following examples:

The MARUM-SEAL – an AUV intended for deep-sea conditions up to 5,000 meters. The device includes a GPS, a pressure sensor, and inertial navigation system, which allow the device to follow a pre-programmed mission course. The device uses multi-beam echo-sounding, side-scan sonar survey, and sub-bottom profiling.
The MARUM-QUEST – a full-sized ROV intended for deep-water. MARUM-QUEST is adaptable for varying deep-sea research needs, and can dive to depths of 4,000 metres.

MARUM-SQUID- a lighter weight ROV which can operate to depths of 2,000 metres. The system is intended for use by smaller research vessels, and is equipped with three scientific cameras, a sonar, and two line-lasers for measuring the ocean floor.

NERIDIS Electromagnetic Seabed Profiler – is a new benthic profiler sled which was developed by MARUM. It carries out controlled source electromagnetic soundings to map the ocean floor and its properties. The profiler is also equipped with a new high-speed flash camera system to provide continuous high resolution optical ocean floor images. As well, the profiler can determine salinity and turbidity of benthic nepheloid layers through its built in CTD system. This method is increasingly popular for determining ocean floor properties.

The Leibniz Institute for Baltic Sea Research Warnemünde, or the IOW

The IOW is a non-university marine research institute. It has four main departments, including marine geology, marine chemistry, biological oceanography, and physical oceanography. Its research programme is directed towards coastal and marginal seas with a special focus on the Baltic Sea ecosystem. In addition to its research activities, the IOW has a transfer strategy, focused on the transfer of its products, roads and targets for the general public, authorities and agencies, and enterprises. The IOW also operates research infrastructures for use by the broader scientific community, including a database of more than 70 million oceanographic publications and metadata for the Baltic Sea.

The IOW is coming upon the end of its 2013-2023 Research Programme, which focused on small and meso-scale processes, basin-scale ecosystem dynamics, changing ecosystems, and coastal seas and society. Across these four research focuses; IOW scientists have been researching the Baltic Sea's ecosystems and how they respond to climate change and human activities.

The IOW also has several projects ongoing – one of which is GEORGE, a next generation multiplatform ocean observing technology. GEORGE will advance the global technological competitiveness of European ocean observing research infrastructures (such as EMSO, ICOS) through a state-of-the-art multi-platform biogeochemical observing system for the characterization of the ocean carbon system. The platform will include three sensors, in conjunction with the latest autonomous technologies to further observing capabilities.

The Senckenberg am Meer institute

The Senckenberg am Meer institute is based in Hamburg, Germany, and is focused on biological and geological coastal and marine research. The Institute includes two main divisions: the Marine Research division, and the German Centre for Marine Biodiversity Research (DZMB). Work conducted through these divisions include actuo-palaetontology, marine geology, marine sedimentology, and marine biology.

The Marine Research division uses tools such as side view sonars, as they call 'Sonar Fish', which scan the surface of the seabed. This tool floats at a constant height above the sea floor, ensuring consistent measuring. The Division also conducts research aboard its research vessel, the Senkenberg.

Conclusion

Germany features a robust blue economy with a wide array of ocean cleantech strengths and activities. While only a fraction of that could be highlighted in this webinar, we are hopeful that the information presented has provided you some valuable information and inspired you to continue to explore.

If you are an SME in Atlantic Canada and would like to further explore this market with more targeted research, there are programs that can help through your provincial government, the Atlantic Canada Opportunities Agency, NRC-IRAP, and Export Development Canada. Also, be sure to connect with Canada's Trade Commissioner Service as a first step to better understand the market and the opportunities that it might present for you.

Be sure to check out our other webinars in this market research series!