



Ministry of Environment
and Gender Equality

National Action Plan for Ocean Acidification

MAY 2025

Table of contents

Overview of the OA Alliance	3
Introduction and challenges	4
National efforts	6
Climate Action	6
Key Agreements	7
Marine environmental efforts	9
International efforts	10

Overview of the OA Alliance

Denmark joined the Ocean Acidification Alliance (OA Alliance) in 2022. The OA Alliance aims to protect coastal communities from the impacts of ocean acidification (OA) and other climate-related challenges by fostering collaboration, optimizing resources, and sharing knowledge. As part of this commitment, Denmark has pledged to develop a national action plan to combat Ocean Acidification. This plan includes reducing greenhouse gas emissions, addressing local pollution, and safeguarding coastal ecosystems, while also raising public awareness about the issue.

The work of the OA Alliance is closely aligned with the global biodiversity goals outlined in the Convention on Biological Diversity's (CBD) Kunming-Montreal Global Biodiversity Framework, particularly Targets 7 and 8. These targets provide a crucial framework for addressing the causes and effects of ocean acidification.

Target 7 focuses on reducing pollution to levels that no longer harm biodiversity or ecosystem functions. This is especially relevant to OA in coastal areas, where nutrient pollution from agricultural runoff exacerbates local acidification by increasing CO₂ concentrations in the water. Addressing these pollution sources is vital for mitigating localized acidification and preserving marine ecosystems.

Target 8 emphasizes reducing the impacts of climate change and ocean acidification on biodiversity. It calls for measures such as cutting CO₂ emissions, implementing nature-based solutions like mangrove restoration, and enhancing the resilience of marine ecosystems through protective efforts, including the establishment of marine protected areas. These strategies are integral to the OA Alliance's mission of reducing ocean acidification's impacts while bolstering the adaptive capacity of ecosystems and communities.

Through the participation in the OA Alliance and the national, regional and international efforts established by Denmark, in alignment with Targets 7 and 8, Denmark is contributing to both local and global efforts to fight ocean acidification.

Introduction and challenges

Approximately 30 percent of the atmospheric CO₂ generated by human activities has been absorbed by the ocean. Ocean acidification will have extensive consequences for marine organisms and eco-systems.

Since the beginning of industrialization, surface ocean pH has decreased by 0.1 units, with this decline attributed to the ocean's uptake of atmospheric CO₂. The chemical processes in the ocean in response to higher levels of dissolved atmospheric CO₂ are well understood and supported by a high degree of scientific confidence¹.

Continued increases in atmospheric CO₂ will contribute to further ocean acidification². As CO₂ levels in the atmosphere rise, more CO₂ is absorbed by the ocean, which in turn reduces the ocean's capacity to take up additional atmospheric CO₂. This uptake of atmospheric CO₂ is the dominant cause of global acidification, accounting for a global pH decline of approximately 0.1 units since the beginning of industrialization. In coastal areas, local factors such as nutrient runoff from agriculture and wastewater also plays a role. These input fuels eutrophication, which leads to an increase in organic matter production.

Subsequently, the degradation of this organic matter may result in a local increase in CO₂ into the surrounding water, creating localized increases in CO₂ levels and contributing to acidification hotspots along the coast³.

Even small changes in ocean acidity, can affect the



oceans ecosystem, particularly marine organisms that rely on calcium carbonate to form their shells and skeletons⁴.

Climate models project that ocean pH will continue to decrease, with estimates projecting a drop of 0.14 to 0.43 units by 2100⁵. Mitigating ocean acidification requires urgent action to reduce CO₂ emissions, primarily by transitioning from fossil fuels to renewable energy sources. This shift not only lowers greenhouse gas emissions, but also plays a critical role in preserving the ocean ecosystem.

In Denmark, the development of pH in coastal

¹ Hoegh-Guldberg, Ove & Cai, R. & Poloczanska, E. & Brewer, Peter & Sundby, Svein & Hilmi, Karim & Fabry, V. & Jung, Steve. (2014). The Ocean

² Miljøministeriet. (2024). Danmarks Havstrategi II - Tredje del: Indsatsprogram 2024 [PDF]. <https://mst.dk/media/mmclxzzm/indsatsprogram-2024.pdf>

³ Cai, Wei-Jun & Hu, Xinping & Huang, Wei-Jen & Murrell, Michael & Lehrter, John & Lohrenz, Steven & Chou, Wen-Chen & Zhai, Wd & Hollibaugh, James & Wang, Yongchen & Zhao, Pingsan & Guo, Xianghui & Gundersen, Kjell & Dai, Minhan & Gong, Gwo-Ching. (2011). Acidification of subsurface coastal waters enhanced by eutrophication. Nature Geoscience. 4. 766-770. 10.1038/ngeo1297

⁴ National Oceanic and Atmospheric Administration. (n.d.). Ocean acidification. NOAA. Retrieved December 6, 2024, from <https://www.noaa.gov/education/resource-collections/ocean-coasts/ocean-acidification>

⁵ Hoegh-Guldberg, Ove & Cai, R. & Poloczanska, E. & Brewer, Peter & Sundby, Svein & Hilmi, Karim & Fabry, V. & Jung, Steve. (2014). The Ocean



waters over the last five decades has reflected both global and local trends. While the increased primary production driven by eutrophication initially led to a rise in pH up until the 1980s, subsequent changes have been characterized by a decline in pH levels. From the 1980s onwards, pH has decreased by approximately 0.1 units in fjords and coastal areas and by around 0.2 units in the open inner Danish waters. This decline is attributed to a combination of increased atmospheric CO₂ levels, which are absorbed by the ocean, and a

reduction in nutrient inputs, which have lowered primary production. Although rising CO₂ would typically be expected to lower pH, the decline observed is greater than anticipated, likely reflecting a shift towards higher respiration rates compared to production. However, since the early 2000s, the rate of decline has slowed, suggesting a stabilization between these two processes⁶.

⁶ Hansen, J. W., Lønborg, C., & Høgslund, S. (Eds.). (2024). Marine områder 2023: NOVANA. Aarhus Universitet, DCE - Nationalt Center for Miljø og Energi. <https://dce.au.dk>

National efforts

Denmark has taken multiple steps toward climate action by implementing various climate policies and initiating a range of climate initiatives. These efforts to reduce greenhouse gas emissions are expected to have a positive impact on the marine environments, as they can help mitigate both ocean acidification and rising ocean temperatures

Climate Action

The Danish Climate Act

The Danish Climate Act sets targets for the country's greenhouse gas emissions reductions. The Act sets targets for a reduction of 50-54% by 2025 and 70% by 2030, compared to 1990 levels. Additionally, the Climate Act ensures that new targets are established periodically in order to achieve climate neutrality by 2050 at the latest. The Minister for Climate, Energy, and Utilities is required to set national climate goals with a ten-year perspective at least every five years, and each new goal must be more ambitious than the previous one.

To reach the targets, the Danish government and a broad range of political parties has agreed on policies focusing on sectors such as agriculture, industry, transport, and energy.

Current emission projections estimate Danish emissions reduced by approx. 56% in 2025 compared to 1990, thus reaching the 2025-target. The projections also estimate that Denmark is on track to achieve a 70% reduction in emissions by 2030 compared to 1990.

To ensure compliance, the independent Climate Council provides ongoing recommendations and assesses whether the government's initiatives are



sufficient to achieve the climate goals. The Council analyzes and comments on various aspects, including the annual climate status, emissions, projects, and climate action plans.

Key Agreements

Climate Agreement for Energy and Industry 2020

The climate agreement sets out initiatives that ensure a transition to market-driven expansion of solar power and onshore wind. The agreement includes among other things funding for carbon capture and storage, support the establishment of large-scale Power-to-X and initiatives contributing to a green transition of industry through energy efficiency improvements, electrification and more green gas. The agreement is expected to reduce Denmark's national emissions by 2.7 million tons of CO₂e by 2030.

The Green Tax Reform

The Green Tax Reform seeks to reduce greenhouse gas emissions while promoting a sustainable and competitive economy. It supports renewable energy through subsidies, encourages green technologies with tax incentives, introduces carbon taxation, and supports the phase-out of fossil fuels. The broad agreement on the green tax reform is estimated to reduce Denmark's CO₂e emissions by 4.3 million tons by 2030.⁷

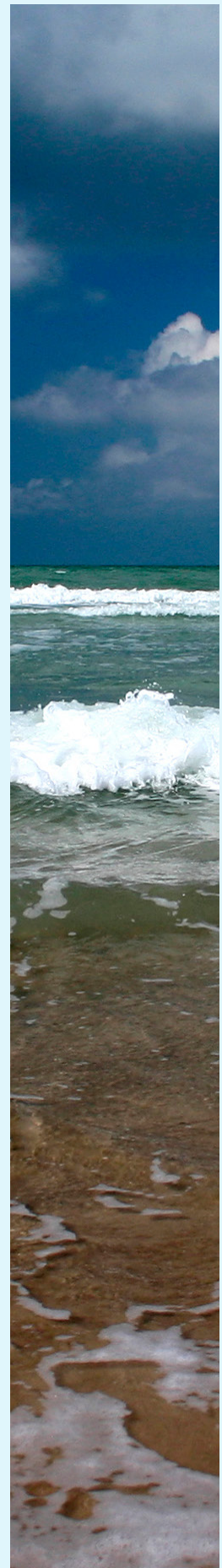
The Climate deal on Green electricity and heating

The 2022 Agreement on Green Electricity and Heating sets ambitious goals for Denmark, including achieving 100% green gas supply by 2030. In 2023 the consumption of renewable energy covered 45.9% of the total Danish energy consumption (excluding fuel for vehicles, ships, and aircraft abroad). This is more than double the share of 2010 in which 20,0% of Danish energy consumption came from renewable sources.

The Climate plan for a Green Waste Sector and Circular Economy

The 2020 Climate plan for a Green Waste Sector and Circular Economy is expected to reduce national CO₂-emissions by reducing waste volumes and increasing recycling. In line with the agreement, tangible initiatives to enhance recycling and lower emissions from the waste sector have been implemented. These are initiatives to reduce Denmark's waste volumes and increase waste sorting and recycling, minimizing the amount sent to incineration plants. Additionally, it is initiatives to scale down incineration capacity and align it with domestic waste levels to prevent surplus capacity from being filled with imported waste. It is also initiatives to strengthen the recycling market and thus strengthen the foundation for investments in recycling facilities.

⁷ <https://fm.dk/nyheder/nyhedsarkiv/2022/juni/regeringen-indgaar-bred-aftale-om-en-ambitioes-groen-skattereform/>



Agreement on Green Transition of Road Transport

Agreements on the green transition of the road transport sector includes initiatives on re-prioritization of the registration tax to increase number of zero- and low-emission vehicles, reducing greenhouse gas intensity of fuels and lowering the electricity tax to charging of zero and low emission cars. The re-prioritization of cars taxation entails that the registration tax for zero-emissions cars is reduced significantly and phased in towards 2035. The agreement is expected to reduce Denmark's national emissions by 1.9 million tons of CO₂e by 2030. Furthermore, Denmark is also obligated to the European target of stopping sales of new petrol and diesel cars by 2035.

The Agreement on a Green Denmark 2024

The Agreement on a Green Denmark 2024 outlines the path to a long-term transformation of Danish agricultural sector, with a focus on reducing emissions, promoting biodiversity, and supporting sustainable land use. A key element of the agreement is the implementation of CO₂ taxes in agriculture and the restoration of carbon-rich lowland soils. This agreement is expected to reduce Denmark's national CO₂-emissions by 1.8-2.6 million tons of CO₂e by 2030.

Carbon Capture and Storage (CCS) Agreements

Denmark has launched several initiatives to promote CCS. Considerable financial resources have been allocated, including approximately DKK 8 billion for Denmark's first full-scale project, which will capture 0.43 million tons of CO₂ annually starting in 2026. Denmark has also created long-term frameworks for CO₂ capture in the energy sector to remove barriers and drive development.⁸

Overall, CCS initiatives are expected to reduce CO₂ emissions by 2.3 million tons by 2030, with further reductions continuing through 2032.⁹

⁸ <https://www.kefm.dk/Media/638632332369380008/Klimaprogram%202024%20-%20Digital.pdf>

⁹ <https://www.kefm.dk/Media/638632332369380008/Klimaprogram%202024%20-%20Digital.pdf>



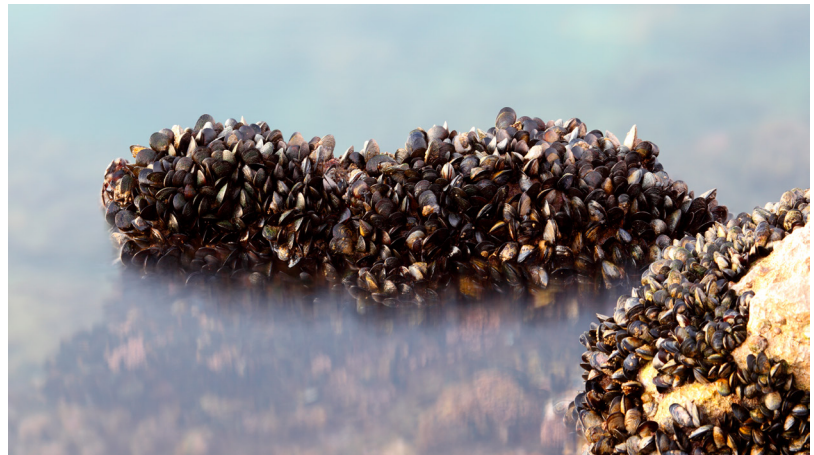
Marine environmental efforts

Initiatives aimed at improving environmental conditions in Danish marine areas are exemplified through Denmark's implementation of EU regulations, such as the Water Framework Directive, the European Marine Strategy Framework Directive (MSFD) and the Nature Directives (The Bird and Habitats Directives), along with regional sea conventions HELCOM and OSPAR¹⁰. In Danish legislation, the 2010 Marine Strategy Act provides the legal framework to ensure good conditions in marine environments, with the goal of reducing pollution inputs, including excessive nutrient pollution¹¹.

One key initiative is the recently agreed Green Tripartite Agreement, which aims to cut agricultural carbon emissions and restore nature. It further supports Denmark's efforts to meet the EU Water Framework Directive by introducing measures to improve water quality, reduce nitrogen runoff, and help create a healthier and more resilient marine ecosystem in Danish waters. Measures such as a carbon dioxide tax, restoring carbon-rich lowlands and expanding forest areas help limit CO₂-emissions and nutrient discharge into coastal waters, addressing factors which can further increase ocean acidification.

Building on this, national initiatives aimed at achieving good environmental status are outlined in the Danish Marine Strategy II (2024), in compliance with the MSFD. A number of initiatives are initiated to support the work towards the MSFD and Good Environmental Status (GES) in Danish marine areas. These include marine protected areas, where human activities are limited to the greatest extent possible to reduce its impact. In 2024, Denmark designated its first strictly protected marine areas, allowing wildlife and marine ecosystems the opportunity to recover. As a result, 31.7% of Denmark's marine territory is now protected. Furthermore, the government, in agreement with all parties in the Danish Parliament, has set a goal for 10% of the marine area to be strictly protected by 2030.

Restoring marine habitats through passive restoration, where physical disturbances are removed from an area or active restoration of e.g. eelgrass beds, mussel banks and rocky reefs can help restore resilient ecosystems and biodiversity and



Blue mussel (*Mytilus edulis*) bed at low tide

through this help mitigate climate change. For example, eelgrass absorbs CO₂ through photosynthesis converting it to organic carbon, when storing it in its biomass. While some of this carbon is eventually released back into the environment, a portion becomes permanently trapped in seabed sediments, contributing to long-term carbon storage. Eelgrass covers an estimated 1,345–2,204 km² in Danish territorial waters. In 2024, Denmark a marine nature fund was established, allocating approximately EUR 67 million to support restoration projects and expand knowledge through comprehensive seafloor mapping, data support, and a tool for ecosystem-based planning¹². This will support active marine nature restoration until 2030.

In April 2024, the Danish government reached a broad political agreement to ban the discharges from open loop/closed loop scrubbers in the Danish territorial waters (out to 22 km from the Danish coast). The ban that covers discharges from the so called open-loop scrubber systems comes into force July 1 2025. The ban on closed loop scrubber discharges, the so called bleed off, will come into force July 1 2029.

Hazardous substances remain to be one of the top pressures in the Baltic Sea.

Discharge of scrubber wash-water from ships is a significant source of hazardous substances, such as heavy metals and tar substances, this contributes to the high pressure on the marine environment.

¹⁰ Regeringen. (2021). Handlingsplan for FN's Verdensmål. <https://fm.dk/udgivelser/2021/juni/handlingsplan-for-fns-verdensmaal/>

¹¹ Bekendtgørelse af lov om havstrategi (Havstrategiloven). Retrieved December 9, 2024, from <https://www.retsinformation.dk/eli/ta/2022/1170>

¹² Regeringen. (2024). Aftale om etablering af Havnaturfonden [PDF]. <https://mim.dk/media/awsdok5i/aftaletekst.pdf>

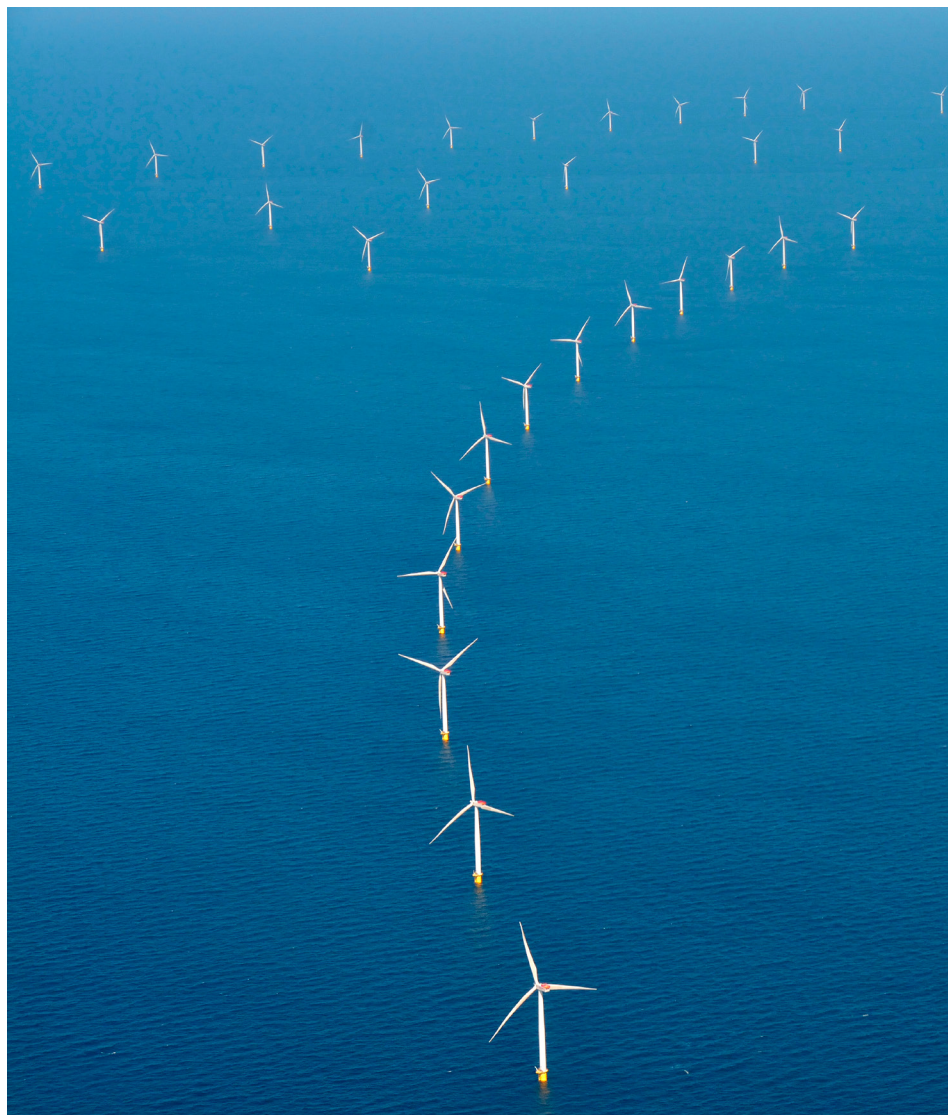
International efforts

Denmark's efforts to address climate change, ocean acidification and the protection of marine environments are driven by both national, regional and international initiatives.

At the regional level, Denmark has supported initiatives linked to ocean management and climate through conventions and collaborative actions, including HELCOM, OSPAR, and ICES, which align with SDG 14.3. These entities have a shared objective which is protection of the marine environment and sustainable use of these environments.

Denmark has supported initiatives in HELCOM and OSPAR linked to climate and ocean management, including the Baltic Sea Action Plan (BSAP) and the North-East Atlantic Environment Strategy (NEAES), which address nutrient pollution as one of the critical factors impacting regional marine ecosystems^{13,14}. In addition to supporting these overarching frameworks, Denmark also actively participated in HELCOM EN CLIME and OSPAR WQ COCOA on monitoring methods as well as the identification of applicable biological and physical/chemical indicators. Furthermore, efforts are being made to understand how adopted policies and recommendations under HELCOM and OSPAR can be influenced by changing climate conditions and ensure that a changing climate is considered.

Beyond HELCOM and OSPAR, Denmark is also a leading participant in the Nordic Ocean Program under the Nordic Council of Ministers and will hold the chairmanship of the program for the next two years, alongside Norway. Within the vision projects NorScen and SAMSKAG, a series of projects have focused on the climate impacts on the marine environment and biological conditions from the Skagerrak to the North Atlantic. New insights into fish stock abundance and possible impact assessments in connection with climate change and its effects were analyzed, and four policy briefs were developed. During the upcoming chairmanship period, efforts will focus on strengthening the



knowledge base regarding climate factors that impact ecosystem functions. Furthermore, the program is expected to address how Marine Protected Areas (MPAs) can enhance the ocean's resilience to climate change and what role climate change will play for biodiversity and the ecosystem as a whole in the North Atlantic.

¹³ OSPAR. (2023). *Inputs of nutrients to the OSPAR Maritime Area*. Retrieved December 9, 2024 from <https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/indicator-assessments/inputs-nutrients/>

¹⁴ HELCOM. (n.d.). Nutrient Reduction Scheme. Retrieved December 9, 2024 from <https://helcom.fi/baltic-sea-action-plan/nutrient-reduction-scheme/>



At the international level, Denmark has implemented marine environmental regulations established by the International Maritime Organization (IMO) through national regulation, such as the Marine Environment Act¹⁵. One of the major focus points here is the reduction of shipping pollution. The Global Ocean Acidification Observation Network (GOA-ON) is an international network for ocean acidification monitoring. Denmark contributes to and participates in this network, by providing data and expertise through Danish marine researchers, ensuring that Danish waters are included in global monitoring efforts. The network goal is to detect and understand the drivers of ocean acidification, the resulting impacts on marine ecosystems, and to make information available to optimize modelling studies¹⁶. Denmark's contribution to global framework conventions is further supported by The Global Environment Facility (GEF), a long-standing Danish partner with which Denmark has contributed a total of USD 465 million since its establishment. The GEF is the largest multilateral fund dedicated to address environmental threats and pressures, such as ocean acidification among many others. The fund has contributed as a financial mechanism to global framework conventions focusing

on ocean acidification such as the United Nations Framework Convention on Climate Change (UNFCCC) and the Convention on Biological Diversity (CBD). Additionally, the GEF manages funds that specifically target global biodiversity issues, such as ocean acidification. The Global Biodiversity Framework Fund (GBFF or GBF Fund) is one of them, which is a financial aid to support the goals established in the Kunming-Montreal Global Biodiversity Framework (GBF)¹⁷ (Target 8 in CBD). Furthermore, Denmark and the EU is an active party to the UNFCCC, including the Ocean and Climate Change Dialogue, a platform that focuses on including ocean-related issues in global climate discussions. The focus is on understanding how climate change affects the oceans and finding ways to protect them while addressing broader climate challenges. Through its involvement, Denmark is helping in the development of solutions that support both ocean health and climate action. The dialogue also brings countries and organizations together to share knowledge and create better plans for the future¹⁸. Finally, Denmark is working to contribute to reducing global greenhouse gas emission in both multilateral fora and through bilateral cooperation.

¹⁵ Miljøstyrelsen. (n.d.). Skibsfart (IMO). Retrieved December 12, 2024, from <https://mst.dk/erhverv/rent-miljoe-og-sikker-forsyning/vandmiljoe/havet/skibsfart-imo>

¹⁶ Global Ocean Acidification Observing Network (GOA-ON). (n.d.). Goals. Retrieved December 12, 2024, from <https://www.goa-on.org/about/goals.php>

¹⁷ Klima-, Energi- og Forsyningsministeriet. (2024). Danish contribution to the Global Biodiversity Framework Fund: Project document.

¹⁸ United Nations Framework Convention on Climate Change (UNFCCC). (n.d.). Ocean and Climate Change Dialogue. Retrieved from <https://unfccc.int/topics/ocean/ocean-and-climate-change-dialogue>



**Ministry of Environment
and Gender Equality**

Frederiksholms Kanal 26
1220 København K

Tlf. : +45 38 14 21 42

E-mail: mim@mim.dk