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荷蘭離岸風電與其海域空間規劃及策略
The Offshore Wind Industry in the Netherlands and Its Marine Spatial Planning and Strategy

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Pay Attention to the Marine Environment and Learn from the Netherlands' Experiences in Increasing Energy Capacity and Reducing Waste

Translated by Linguitronics

Minister of the Ocean Affairs Council: Chung-Wei Lee

The changes taking place in the marine environment deserve global attention. The United Nations (UN) released the second World Ocean Assessment this year (2021). In addition to documenting the ecological, economic, and social aspects of the marine environment in a comprehensive manner, the Assessment also reminded us to manage the oceans properly and utilize measures such as innovative technology, knowledge integration, and building our energy capacity to ensure sustainable marine development. In addition to providing an analysis of the Assessment in our "International Issues" column, this issue also introduces ocean governance and technology development in the Netherlands. In "Organization Focus", we analyze the Dutch Ministry of Infrastructure and Water Management's policy planning related to marine transportation, the management of water resources and piers, and sailing and small boats. In "Industry Dynamics" we introduce the circular economy policies and waste-reduction technology in the Netherlands. We also cover stories of local businesses turning recycled marine debris into carpets, sofas, and skateboards, thereby enhancing the value of marine debris. In "Latest News", we focus on the multi-functional Space@Sea large-sized floating island that is an energy hub, living space, and farm on the sea as well as serving as a logistics center at sea. It was developed by the Maritime Research Institute Netherlands (MARIN).

At a time when Taiwan is actively developing offshore wind power, we hope to learn from the Netherlands' experiences. We invited the Netherlands Enterprise Agency (RVO) to write an article (provided by the Netherlands Office Taipei) for the "Special Report" section. The RVO share the ten-step policy measures enacted to reduce risks related to offshore wind power development during energy transformation. In addition to creating a favorable market and bidding criteria for project developers, the measures also demonstrated the leading role of the Dutch government. In "Regulatory Systems", we discuss the coordinating role that the Physical Environment Consultative Council (OFL) played in stakeholder negotiations in order to reach a consensus in the North Sea Agreement (NSA). The Netherlands' experiences in offshore wind power development can serve as a reference for Taiwan's negotiation methods regarding the use of Taiwan's offshore regions.

Concept image of an artificial offshore wind power island in the North Sea
Source/ Tennet
https://www.tennet.eu/company/news-and-press/footage/footage-tennet/

The Offshore Wind Industry in the Netherlands and Its Marine Spatial Planning and Strategy

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Keywords: offshore wind industry, marine spatial planning, Netherlands

The Dutch energy transition is in full swing and offshore wind is a cornerstone of the climate ambitions of both the government and the private sector. Because of a strong history in maritime operations, an innovative rollout policy and continuous innovation, the Dutch has also become a renowned player in the international offshore wind business. The Netherlands are committed to the Paris Climate Change Agreement. The Dutch government has presented a clear 11.5 GW pipeline of offshore wind projects until 2030 and is now discussing the post 2030 outlook. The Dutch government pre-designated wind farm zones combine with a tender-permit system creating a clear outlook for developers. The government also takes responsibility for the site studies and offshore grid connection, de-risking plans for developers and increasing investor confidence.

Today's regulatory and tender framework for offshore wind tackles the disadvantages of the previous policy approach until 2013, in which project developers alone were responsible for the site selection, investigations and permitting process and faced high cost and risk perceptions before they could apply for subsidies. As a result, out of 80 initial applications, only four offshore wind farms were actually built in the Dutch Economic Zone of the North Sea until 2017, with a total installed capacity of less than 1 GW.

The current policy approach in contrast is much more proactive: by regulating conditions for the construction of the wind farms - i.e. exact locations, steady tender plans, consents, grid connections, operating grants if necessary - the Dutch government helps to reduce pre-bid investment risks, financing and - last but not least - societal costs.

The current policy approach can best be explained in 10 steps, showing a leading role for the government and by creating favourable market and tender conditions for project developers.

Step 1. Designating The Wind Farm Areas

The Dutch legislative offshore wind framework starts with early spatial planning. Through the National Water Plan, which finds its legal base in the Water Act, the Ministry of Economic Affairs and Climate Policy and the Ministry of Infrastructure and Water Management allocate the areas for future offshore wind farm development in the Dutch territory of the North Sea. Each area can include one or more wind farm sites. The development of offshore wind farms will be restricted to these areas, and permits will not be awarded for wind farms outside these areas.

Step 2. Drawing Up Offshore Wind Farm Tender Roadmaps (roll out plans)

The specific roll-out sequence in which the wind farm area's and included sites will be developed, the projected generation capacity of the individual sites and the year of tendering for installation and operation, are scheduled in the Offshore Wind Energy Roadmap.

The Offshore Wind Energy Act, in which the Roadmap is legally based, was introduced in 2015 in close consultation with the wind energy sector. The purpose of this law is to guarantee optimal efficiency in the use of marine space and to provide a decade-long pipeline of tenders as an assurance for project developers. Two offshore wind farm Roadmaps have been issued by the government so far.

As stated in the National Energy Agreement (2013), the Dutch government published in 2015 a first Tender Roadmap (2015-2023), aiming at adding a total of 3.5 GW offshore wind power capacity in 2023. The Roadmap announced the release of five offshore windfarms, all to be tendered between 2016 and 2019 and the last one expected to be in operation in 2023.

Encouraged by the successful rollout of tenders in the first roadmap, the government released another Roadmap (2023-2030) in 2018, announcing an additional 7 GW offshore wind development before the end of 2030. This roadmap schedules the release of wind farm to be tendered between 2021 and 2026 and the last one to be in operation in 2030. The Roadmap 2023-2030 includes the zones Hollandse Kust (west), Ten Noorden van de Waddeneilanden and IJmuiden Ver.

Step 3. Conducting Studies

Following the parliamentary approval of the roadmap, the foreseeable offshore wind farm sites will be subject to a comprehensive environmental impact assessment, leading to a ministerial wind farm site decision (to be explained in step 5). A series of geo-physical site studies will be executed in step 3.

To analyse and - if necessary - deal with the economic, social and ecological impacts of the wind farm(s), the site decisions are legally subject to an environmental impact assessment (EIA), commissioned by the Ministry of Economic Affairs and Climate Policy and the Ministry of Infrastructure and Environment. The EIA results will be published in the site decision (step 5), available for public inspection (and appeal), after which it becomes irrevocable.

Apart from the EIA, the government also conducts a series of local site studies (soil- wind- and water). Examples are the meteorological and oceanographic survey, the soil survey, the ecological soil survey, the archaeological survey and UXO surveys. Similar to the EIA, the outcomes of these site data studies will be made available for project developers for their FEED studies to submit competitive bids in the tendering procedure (see also step 6).

Project developers (permit applicants) therefore do not have to make an environmental impact assessment and perform the site studies of their own. The costs in relation to these surveys are for the account of the State and will not be borne by the competing project developers. The Netherlands Enterprise Agency (RVO) will commission and publish the site data packages. All studies and investigations are officially certified or quality approved.

Step 4. Installing The Grid Connection

The Dutch national electricity Transmission System Operator TenneT is legally appointed to be responsible for the connection of the wind farms to the onshore electricity grid. As the planning and installation of this offshore grid network generally takes 8 to 10 years (depending on the distance, technique and permit procedures and subject to EIA), this grid installation decision is taken as early as possible in the process. The permit for TenneT is made publicly available for inspection (and appeal) by all parties, after which it becomes irrevocable.

The choice for TenneT to be the offshore grid system operator has clear advantages over individual grid connections installed by project developers. The advantages are mainly financial and related to economies of scale following standardization in substation design, purchasing, maintenance and knowledge development. Grid operation by TenneT also simplifies compensating grid fluctuations, flow management, and balancing supply and demand, whilst integral grid operation also leads to a clear distribution of tasks and responsibilities in the electricity system.

To create the cost-saving economies of scale, standardized AC-substations (with a capacity of 700 MW each) have been designed to connect the wind farms to the national grid, using two 220kV export cables. As soon as 380kV subsea cables become available, this will be applied to further reduce the amount of required cables.

For offshore wind farm further away from the coast, DC-substations are needed. The connected transmission capacity is approximately 2 GW and an onshore converter station via two 525kV cables will be part of the offshore grid.

The inter-array (infield) cables, which connect the wind turbines to the substation remain the responsibility of the project developer. The wind turbines will be connected to the TenneT platform through 66kV infield cables, making the Dutch offshore wind parks the first in the world to be connected by a voltage level of 66kV instead of 33kV.

To plan the public investments in the offshore grid, the government provides guidance through a development framework. This framework outlines the design and construction of the offshore grid and its main functional and technical requirements. It also stipulates the tasks of TenneT as offshore transmission system operator, provides the sequence of the development of the sites and sets the timetable for commissioning of the connection for the sites. On the basis of the development framework, TenneT draws up a bi-yearly investment plan setting out the envisaged investments, performance targets, deadlines and plans for capacity expansion. The investment plan needs approval from the Dutch regulator, the Authority for Consumers & Markets.

TenneT and the offshore wind farm operators sign a realization agreement as well as a connection & transmission agreement. The agreements set out the terms and conditions regarding the development of the connection for the wind park, addressing aspects such as the basic design and technical specifications of the connection and the substation as well as operational arrangements and the exchange of information between TenneT and the wind park developer. In case of a delay or unavailability of the offshore grid, TenneT is legally committed to compensating the wind park owner for postponed or missed (subsidy) revenues from electricity sales and consequential damages.

Step 5. Consenting: Taking The Wind Farm Site Decision

Following the initial assignment of wind farm areas (step 1), the Roadmap planning (step 2), EIA-assessment (step 3) and offshore grid decision (step 4), the government is now ready to publish the wind farm 'Site Decision'. The wind farm site decision is the cornerstone of the Dutch Offshore Wind Energy Act. Offshore windfarms can only be built after a permit, based on the site decision, has been issued. A wind farm site decision is therefore the necessary consent required to build a wind farm and specifies the location for the wind farm and the conditions under which it may be constructed and operated, taking issues into considerations such as ecology and decommissioning of the windfarm. These conditions can be related to wind turbines (minimum power, maximum tip high & minimum tip low) and infield cables (prohibited outside wind farm site boundaries). The site decision however leaves some flexibility for the design of the wind farm. This means that project developers have the opportunity to choose the latest technical innovations - within the natural and environmental framework – to realise and operate the windfarm at the lowest possible costs.

The site decision is subject to public consultation and possibly appeal. At the end of the consultation phase, the Wind Farm Site Decision becomes irrevocable in case there are no further appeals.

Step 6. Organising The Tender

As the Wind Farm Site Decision has become irrevocable, the government starts the tender. All tenders kick-off with a Ministerial Order, including tender rules for the relevant offshore wind sites. Examples are the timing of the tender, the deadline for commencement of operation, the maximum tender amount and base electricity price, the minimum and maximum capacity of the wind park and tender eligibility criteria, and criteria for ranking the bids. After the tender closure, the Minister of Economic Affairs and Climate Policy will appoint the winner within 13 weeks, a period which may be extended by another 13 weeks. The award decision is subject to objection and appeal proceedings by competing tender participants. Objections must be filed within six weeks of the date of the tender award. Subsequent appeals can be filed within six weeks of the date of the decision on the objection.

The current legislative tender framework distinguishes three optional tender models to select for future use: the tender for lowest subsidy bid, tender for best feasibility (+ financial) offer and tender for highest auction price.

The Law 'Windenergy at Sea' is currently subject to some legal changes with the purpose to 1. create more choice in (zero-subsidy) tender models, 2. include other sources of renewable energy such as hydrogen and 3. extend the duration of the permit from 30 to 40 years. Parliamentary approval is expected in the course of 2021.

Step 7. Granting The Permit

Immediately after winning the tender, the government grants the permit for the construction, operation and the removal of the wind farm. With this permit, the winning developer can immediately start constructing the wind farm. The permit states that the wind farm must be constructed within four (eventually five years) and is valid for a maximum of 40 years.

Step 8. Monitoring Wind Farm Preparation

Once granted the permit, the wind farm developer must comply with its plan for the construction and operation of the wind park as submitted together with the application. As stated in step 5, the permit remains flexible for innovation and therefore allows for certain permit changes in relation to the development or operation of the wind park. Examples of so-called essential changes to the production installations are the number of turbines of the production installation, the positioning of the turbines, the hub height, type of turbine and type of foundation. A request for an exemption must be accompanied by an explanation of the effect of the change on the aspects set out above, as well as by an amended wind energy yield calculation (if applicable). Any deviation from the original plan requires an exemption granted by the Minister of Economic Affairs and Climate Policy. This way the wind park developers are enabled to use the most up-to-date technology and pursue cost reductions through innovation.

Step 9. Monitoring Wind Farm Construction

The Directorate-General for Public Works and Water Management (Rijkswaterstaat, RWS) monitors the planning, construction, and operation of wind farms. The monitoring activities vary per phase. The planning phase mainly includes the assessment of the work plans drawn up by the permit holder. During the construction phase, inspections are performed via ships and aircraft of the Netherlands Coastguard and the State Supervision of Mines.

Step 10. Monitoring Wind Farm Operation

The wind farm operation results in the generation of electricity. During the operational phase, RWS monitors the operations management and maintenance activities. After a maximum of 40 years, the wind farm will be decommissioned and removed. The permit is no longer valid after that period.

Conclusion

It is safe to conclude that the introduction of this 10-step approach is proved to be a 'game changer' for the development of offshore wind in the Netherlands. The 10 steps approach helps to de-risk the development of the offshore wind farms and lower the cost for the developers. Together with a roadmap aiming at connecting each year 1 GW of offshore wind capacity to the grid, the confidence of developers grew which resulted in zero subsidy bids and record low prices. While there was only little activity in offshore wind under the previous policy up to 2013 (resulting in approx. 1 GW capacity in total), under the current policy approach a total of 3.5 GW was successfully tendered between 2016 and 2019 and an additional 7 GW offshore wind farm capacity in now being scheduled, leading into a total 11.5 GW installed offshore wind capacity in 2030.

It proves the importance of a public-private process guided by the government setting parameters for the pace at which the proposed new capacity will be developed, the maximum capacity of the wind farms; planning and zoning; site investigations and last but not least the grid connection. By regulating all conditions for the construction of the wind farms the Dutch government reduces project risk, financing and – last but not least - societal costs.

Today, the Netherlands is a front-runner in cost efficient offshore wind development and installation. International attention for the Dutch approach to offshore wind energy, the tender system and location studies, has increased in recent years. The construction of wind farms in the North Sea has created confidence in offshore wind energy worldwide.

Understanding the Ocean: The Second Ocean World Assessment

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Keywords: Marine environment, evaluation, socioeconomic aspects

In its resolutions 57/141 and 58/240, the General Assembly of the United Nations decided to establish a regular process for global reporting and assessment of the state of the marine environment, including socioeconomic aspects. The aim of the regular process is to provide an evaluation of the state of the global ocean, the services that it provides and the human activities that influence its state. The first World Ocean Assessment was completed in 2015, establishing a baseline and pointed out many parts of the ocean has been seriously degraded and that, if the problems that it described were not addressed, they would produce a destructive cycle of degradation in which the ocean could no longer provide many of the benefits on which humans rely. Following the first Assessment, the second cycle of the regular process for the period of 2017-2020 was launched. The second Ocean World Assessment was issued in 2021, which builds on the baseline established by the first Assessment and further extends to evaluate the changes and trends of the marine environment.

Marine Protected Areas can alleviate impacts of human uses to the marine environment
(photo taken at Channel Islands National Park)
Image by Chung-Ling Chen

The structure of the Second Ocean World Assessment

The Second Ocean World Assessment (hereafter the Assessment) consists of 28 chapters, which are assigned in two volumes. The chapters from Chapter 1 through Chapter 7 are collected in Volume I with a total of 570 pages. The remaining chapters from Chapter 8 through Chapter 28 are compiled in Volume II with a total of 520 pages. The content it contains is very enormous and diverse, mainly including the trends of the marine environment, the impacts of various human activities on the marine environment, and development of management approaches. It comprehensively documents the information regarding ecological, economic and social aspects of the marine environment. A linkage was adequately made between the Sustainable Development Goal 14: Conserve and sustainable use the oceans, seas and marine resources, which was adopted by the United Nations in 2015.

Volume I focuses on the approaches to the assessment, scientific understanding of the ocean, drivers of change in the marine environment and trends in the physical, chemical, biological states. Volume II takes care of the trends of, or changes in various human activities at sea (e.g., capture fisheries, aquaculture, seabed mining) and the associated problems (e.g., nutrient inputs, liquid and atmospheric inputs, inputs of solid waste, coastal erosion), the environmental and socioeconomical impacts of human activities, and the key remaining gaps in knowledge and capacity-building. In addition, it examines the developments of management approaches (e.g., marine spatial planning) as well as in the overall benefits from the ocean to humans in the last chapter.

The title of each chapter of the Assessment is presented as follows.

Volume I

Chapter 1: Overall summary

Chapter 2: Approaches to the assessment

Chapter 3: Scientific understanding of the ocean

Chapter 4: Drivers

Chapter 5: Trends in the physical and chemical state of the ocean

Chapter 6: Trends in the biodiversity of the main taxa of marine biota. A total of seven subchapters are under Chapter 6, including plankton (phytoplankton, zooplankton, microbes and viruses), marine invertebrates, fishes, marine mammals, marine reptiles, seabirds, marine plants and macroalgae.

Chapter 7: Trends in the state of biodiversity in marine habitats. A total of 17 subchapters are under Chapter 7, including intertidal zone; biogenic reefs and sandy, muddy and rocky shore substrates; atoll and island lagoons; tropical and subtropical coral reefs; cold water corals; estuaries and deltas; seagrass meadows; mangroves; salt marshes; continental slopes and submarine canyons; high-altitude ice; seamounts and pinnacles; abyssal plains; open ocean; ridges; plateau and trenches; hydrothermal vents and cold seeps; Sargasso Sea.

Volume II

Chapter 8: Trends in the state of human society in relation to the ocean. Two subchapters are under Chapter 8, including coastal communities and maritime industries, and human health as affected by the ocean.

Chapter 9: Pressures from changes in climate and atmosphere

Chapter 10: Changes in nutrient inputs to the marine environment

Chapter 11: Changes in liquid and atmospheric inputs to the marine environment from land (including through groundwater), ships and offshore installations

Chapter 12: Changes in inputs and distribution of solid waste, other than dredged material, in the marine environment

Keynote points

Due to the enormous amount of information contained in the Assessment, this section presents the keynote points as follows.

- Some measures for mitigating or reducing pressures and their associated impacts on the ocean have improved since the first Assessment was issued. One of measures is the expansion and implementation of management frameworks for conserving the marine environment, including the establishment of marine protected areas and improved management of fisheries and pollutions. However, many pressures from human activities continue to degrade the ocean (e.g., mangroves and coral reefs), including unsustainable fishing (e.g., illegal, unreported and unregulated fishing), the introduction of invasive species, ocean acidification, excessive inputs of nutrients and hazardous substances (e.g., plastics, microplastics and anthropogenic noise) and ill-managed coastal development and extraction of natural resources.
- There continues to be a lack of quantification of the impacts of pressure and their cumulative effect effects. A failure to achieve the integrated management of human uses of coasts and the ocean is increasing risks to the benefits that people draw from the ocean, in terms of food safety and security, material provision, human health and well-being, coastal safety and the maintenance of key ecosystem services.
- Improving the management of human uses of the ocean can ensure sustainability. It requires capacity-building; innovations in marine technology; the integration of multidisciplinary observation systems; integrated management, planning and improved access to, and exchange of, ocean knowledge and technologies.
- The coronavirus disease (COVID-19) pandemic is having a major effect on many human activities carried out in the ocean. The full implications of the pandemic on human interactions with ocean are yet to be fully assessed.
- Drivers are characterized as social, demographic and economic developments in societies, including changes in lifestyles and associated consumption and production patterns. They apply pressures to the ocean. Relationships between drivers and pressures are complex and dynamic. The drivers identified are: population growth, economic activity, technological advances, changing governance structures, geopolitical instability, and climate change.

- The lack of appropriate wastewater treatment and the release of pollutants from the manufacturing industry, agriculture, tourism, fisheries and shipping continue to put pressure on the ocean. They pose a negative impact on food safety and security and marine biodiversity. Marine litter is a further problem, given that, in addition to the environmental and economic damages caused by its presence, it can carry pollutants and non-indigenous species over long distances.
- The main threats to marine ecosystems come from human activities, such as fishing, aquaculture, shipping, sand and mineral extraction, oil and gas exploitation, the building of renewable energy infrastructure, coastal infrastructure development and pollution, including the release of greenhouse gases. Many management frameworks for protecting marine ecosystems have a sectoral focus and can therefore have differing objectives for the protection of the marine environment across sectors. Management tools can be area-based (such as marine protected areas and fishery closures) or non-areas-based (such as global emission controls, catch and effort controls, and technical restrictions). They are increasing moving away from being focused on sectoral use towards the ones caring for diverse links between ecological, social, economic and cultural aspects. In addition, cultural information is becoming an integral part of management frameworks, both in the context of community-based management and for safeguarding the cultural dimension of the marine environment.
- Understanding the ocean facilitates sustainable management. Innovations in technology and engineering related to sensors and autonomous observation platforms have allowed for ocean data collection at finer temporal and spatial resolutions and expanded those observations into remote areas. Cost-effective and user-friendly sensors and mobile applications, the enhanced participation of citizens, and the deployment of sensors on non-scientific ships, all facilitate the expanded collection of ocean observations. Such developments have increased understanding of physical and biogeochemical systems in the ocean and how the ocean is changing in response to climate change, as well as enhanced ocean modelling capabilities at the global and regional scales.
- A wide range of events including tsunamis, storm surges, rogue waves, cyclones, hurricanes and typhoons, erosion, marine heatwaves and harmful algal blooms, together with various effects of hazardous substances and excessive nutrients, have the potential to threaten food security and hamper sustainable economic development.
- Animal protein from the seas, which is largely derived from wild fisheries, provides about 17 percent of all animal protein consumed by humans and supports 12 percent of human livelihoods. However, the contribution of aquaculture to food security is growing rapidly and has greater potential for growth than capture fisheries. Fishing is by itself a stressor on the marine environment, and the expansion of aquaculture brings new or increased pressures on marine ecosystems, in particular coastal areas.
- The ocean supports a wide range of economic activities, including seabed mining, extraction of offshore hydrocarbons, maritime transport, tourism and recreation, marine genetic resources, marine renewable energy, etc. All maritime industries are highly dependent on technology to operate safely and reduce damage to the marine environment. With regard to marine genetic resources, capacity-building remains an issue, as most work in this field is carried out in a small number of countries. There is therefore a need to build skills relating to the development of marine genetic resources in many countries in order to develop their blue economy sustainably.
- The United Nations Convention on the Law of the Sea (hereafter the Convention) establishes a delicate balance between the need for economic and social development through the use of the ocean and its resources and the need to conserve and manage those resources in a sustainable manager. In addition to its two implementing agreements (Agreement Relating to the Implementation of Part XI of the UN Convention on the Law of the Sea [1994 Part XI Agreement]; and Agreement for the Implementation

of the Provisions of the UN Convention on the Law of the Sea relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks [1995 Fish Stocks Agreement].), the Convention is supplemented by numerous global and regional legal instruments, covering many aspects of ocean use. One example at the global scale is the International Convention for the Prevention of Pollution from Ships (MARPOL). The other example at the regional scale is the Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean. However, due to a lack of financial, technological and human resources, some countries fail to fulfill a State's obligations by effectively implementing these instruments. In particular, many small island developing States and least developed countries lack access to the detailed knowledge and skilled human resources needed for ocean management, and resources for managing the large marine areas under their jurisdiction are often limited.

- The Assessment specifies the links between the chapters and the Sustainable Development Goal 14 (Conserve and sustainably use the oceans, seas and marine resources for sustainable development) and its associated targets. As an illustration, Target 14.1 pertaining to cleaning up the ocean corresponds to Chapter 10, 11, 12 and 20. Target 14.2 pertaining to protecting and restoring marine ecosystems corresponds to Chapter 6 and 7. Target 14.3 pertaining to reducing ocean acidification corresponds to Chapter 5, 9. 10, and 13. The SDG 14 is reflected in the last chapter – Chapter 28.
- The Assessment lists a wide range of mechanisms associated with SDG 14 targets. For example, the mechanisms corresponding to Target 14.1 are improved wastewater management; sustainable urbanization and reduction in the environmental impact of cities; improved access to science, technology and innovation; enhanced knowledge-sharing and transfer of technology and capacity-building.

Table 1/ Sustainable Development Goal 14 associated targets

Target 14.1	By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution.
Target 14.2	By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans.
Target 14.3	Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels.

Conclusion

Following the publication of the First Ocean World Assessment in 2015, the Second Assessment was published in 2021. The second Assessment further provides the updated information on the state, changes and trends of the marine environment at the global scale. The content it contains is comprehensive, particularly covering the impacts of human activities on the marine environment, developments of management approaches and the information relating to the overall benefits derived from the ocean. It also adequately links with the SDG 14 and the associated targets and further lists the mechanisms in achieving these targets.

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Management Policy of Marine Debris in the Netherlands

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Translated by Linguitronics
Keywords: the Netherlands, circular economy, marine debris, upcycling

The Netherlands is a European country with a slightly larger area and a slightly smaller population than Taiwan. It is also humid and rainy, much like Taiwan. Furthermore, similar to Taiwan, its land is scarce, which led to the development of high-value added agriculture such as flowers, fruits and vegetables. TSMC is known as one of Taiwan's major economic drivers, and it supplies electronic chips all over the world. The Netherlands, on the other hand, is home to several global brands such as the oil and gas company Royal Dutch Shell, Philips, one of the largest household electronics companies in the world, and the food conglomerate Unilever. However, when it comes to addressing marine debris issues, the Netherlands has adopted a strategy that differs from Taiwan. We focus on marine debris itself and propose actionable solutions to reduce plastic from the source, while also putting more effort in cleaning up waste. The Netherlands, on the other hand, proposed its policy from a macro prospective: Indeed, marine debris is a threat to sea creatures and the marine environment. But what if what people produce don't end up as waste all at?

Circular Economy in the Netherlands

Before looking into the Netherlands' policy, let us first recap humanity's current way of life. Almost everything that is associated with our way of life are products of a linear economy. Upstream factories produce raw materials, and through processing, designing, manufacturing and delivery, the product becomes available on the market. We then consume, use and dispose them of them before buying a new product. After people learned about recycling and started doing it, some materials then began to cycle back into the manufacturing process. Unfortunately, under the current system, not all things can be recycled. For example, most household products use compound materials. Take a hair dryer for example, it consists of an ABS outer shell, a PP mouthpiece, metal coils, ceramic heat shields and electric wires wrapped in PVC plastic. Unless they are all dismantled, no recycling plant would accept them. Moreover, though some materials can be recycled theoretically, such as PS, if they only come in a small amount or have a low market value, then it will be disposed of as common trash despite being a recyclable material, because recycling them is not economically worthwhile.

In contrast to solely focusing on recycling, the Dutch government wants to reduce the chances of items becoming waste. To achieve this goal, in addition to reusing a product, it is also possible to extend the life cycle of a product through product design, repair, renovation, reassembly, and reconstruction of materials (such as kiln-burning non-toxic industrial waste into paving materials for constructions, or transforming leftover plant material into food containers). The goal of the Dutch government is to replace the current linear economy with closed-loop economy. By 2030, it aims to reduce the amount of raw materials used by half, and attain a circular economy by 2050 [1].

This ambitious goal is confronted with many challenges. On the production side, the Dutch need to be pioneers in the design and manufacturing of closed-loop products; they even have to develop new sustainable uses of natural resources to reduce material consumption. On the consumption side, consumers need to be more aware of the products they buy and use to reduce the amount of waste generated. The total amount and quality of waste are indicators of circular economic activities. Hence, people need to recycle more and recycled items must be better processed. The central government greatly encourages its people and businesses to embrace the circular economy through the following three actionable solutions. First, strengthening the network of innovation by connecting different departments with sustainable startup groups. Second, tearing down the barriers from laws and regulations, including law amendments, license issuance and permitting room for experiments. Third, gaining market support through procurement and enhancing public awareness [2].

It is more valuable to completely dismantle and reuse: The innovative path to recycling waste

The type of recycling that we are familiar with is known as downcycling. The strength and quality of recycled materials cannot be on par with the original materials, leading to a downgrade of value after recycling. The conventional recycling of paper and plastic are all downcycling. For example, paper is recycled into newspapers of lower paper quality, or recycled plastic bottles are made into flower pots or photo frames. In contrast to downcycling, upcycling is adding value to materials after they are recycled.

Is it possible to turn stone into gold? The Dutch have proven that they're not all talk and no action when it comes to realizing sustainability. In 2018, 85,000 circular economic activities were created in the Netherlands, creating 420,000 job opportunities [3]. To continuously incentivize businesses, the Dutch Ministry of Infrastructure and Water Management set aside 40 million euros to fund circular economy projects in 2019 and 2020. Municipal strategies and the Sustainable Development Goals also led to financial support for businesses in this period of transformation [4].

Figure 1/ Interface buying old fishing nets from fishermen
Source/ Net-Works

Through the dual support of government policies and fiscal policies in the Netherlands, many businesses now view waste as new materials instead of the useless things they used to consider them, and will turn them into new products through recycling. This not only reduced dependency on raw materials and natural resources, but also created new business models. The global leader in carpets and modular flooring, Interface Inc., noticed that abandoned fishing nets are hazardous for the environment. They also noticed that both fishing nets and carpets are made of nylon. Therefore, the company launched the Net-Works program in the Philippines and the Republic of Cameroon, recycling local fishing nets into yarn for carpets. This not only created revenue for the fishermen, but also reduced the usage of petrochemical materials in making carpets. Furthermore, the program reduced the harm abandoned fishing nets have on wild animals. Now, 58% of the materials used to make Interface carpets comes from recycled or biological sources. Compared to 1996, Interface has reduced its carbon emissions by 95%, and is dedicated to bring more benefits for poor families.

Another company that also produces carpets is called Niaga (the word "again" in reverse), incorporating the concept of reusing materials in product designs and adding recycling into the product's life cycle. Every item from Niaga comes with a tag instructing consumers to return it instead of throwing it away. If all consumers can return recyclable products back to the company for collective recycling, the materials can then be reused continually. Niaga recycles bed mattresses and carpets by extracting the nylon or woolen fibers and utilizing technology to reduce production costs and the consumption of energy and water.

Creating plastic that lasts forever? This is not a fantasy, it is actually a unique technology by Ioniqa. Due to the physical properties of plastics, every time we recycle, the polymer chains in the plastic are broken. This results in less strength and toughness after each recycle and forces us to add new plastic materials as reinforcement. The technology that Ioniqa developed can repeatedly remake PET (polyethylene terephthalate, or the material used to make plastic bottles) into high quality, transparent, good-as-new plastic ester pellets. PET polymer is widely used in water and beverage bottles, packaging, functional clothing and carpets. We use up to 61 million tons worldwide annually, but 90% of them end up in incinerators or as environmental litter. Ioniqa wants to change the fate of PET polymer and created recycled plastic with quality and price competitiveness.

Figure 2/ Bottle cap patterns are clearly visible on a WasteBoards skateboard
Source/ WasteBoards

Other companies are also involved in the quest to turn trash into gold, including furniture manufacturer Van de Sant, skateboard company WasteBoards, and Dutch-Kenyan firm Ocean Sole. Van de Sant reprocesses, melts and reshapes plastic waste from land and the ocean into sofas. These furniture go on to become key fashionable items in business hotels, exhibitions, and banquets. The skate board company WasteBoards collaborated with the Plastic Whale Foundation, which guides people and children to pick up trash from the waterways when touring on boats in the canals of Amsterdam. More than 12,500 people have participated, and they have cleaned up more than 100,000 plastic bottles, as well as enough plastic waste to fill more than 2,000 plastic bags. The trash from the canals then undergo a selection process to pick out the useful items; 1,000 plastic bottle caps can go through 3 hours of heating and melting to be made into a brand new skateboard, with the patterns of the 1,000 bottle caps upon it.

With the help of a Dutch company called Nic & Mic, Kenya's Ocean Sole turns slippers picked up during beach cleaning into 3D animal sculptures with vibrant colors and different sizes through the skilled hands of artists. In 2018, 750,000 slippers were sculpted and transformed into artistic masterpieces of different sizes by 80 local artists. Some are suitable for home or office decorations, while others are large pieces of installation art, such as life-size giraffes and lions.

The most ambitious fundraising event in history to eliminate marine debris once and for all

It's not just repairing, reassembling, and recycling materials to extend a product's life cycle. For waste that is already littering the environment, the Dutch incubated many startup teams that combined engineering and technology. The solutions they proposed to solve plastic pollution issues include ocean cleanup system, Bubble Barriers, and CLEAR RIVERS. Detailed descriptions for the solutions are as follows.

In 2013, a young Dutchman named Boyan Slat (who was 18 at the time) was deeply shaken after witnessing marine debris while snorkeling. He launched an NGO "The Ocean Cleanup" to eliminate ocean plastic waste and created the cleanup system. It was hailed as the best invention of 2015, a miracle in ocean cleanup technology, and even received more than 40 million USD in funds. However, the performance of the system wasn't up to expectations, some even split apart in the sea before they had completed their mission. The team could only drag the system back to the port for assessment and correction.

In addition to cleaning marine debris, the Ocean Clean Up team knew all too well that the speed of cleaning up marine debris is far slower than the speed of waste being dumped into the ocean. According to the team's scientists' latest research, approximately more than 1,000 rivers across the globe flush 80% of river debris into the ocean [5]. Hence, they also developed the River Interceptor. The River Interceptor has a life span of 20 years, is 100% powered by solar energy, and is fully automated. It is now used in Indonesia, Malaysia, Vietnam, and the Dominican Republic. The team also signed contracts with Thailand, Honduras and the United States, hoping to stem marine debris issues by solving river debris issues.

Figure 3/ An Interceptor on a river in the Dominican Republic
Source/ The Ocean Cleanup

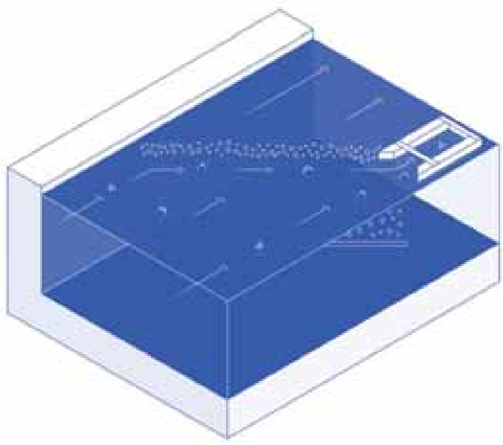

Figure 4/ Operation principles of a Bubble Barrier
Source/ The Great Bubble Barrier

Another innovation that also focused on river debris is the Bubble Barrier in the canals of Amsterdam. The principle of a Bubble Barrier is to first lay a pipe drilled with small holes at the bottom of the canal. Then a compressor is used to blow air into it, creating a barrier of bubbles. This barrier can create an upward current like an invisible interceptor, pushing plastic waste up to the surface of the canal. The team installed Bubble Barriers at opposite corners of a canal, which allows the current to push plastic waste to the banks on either side and right into collection devices. The Bubble Barrier can run all day long, increasing dissolved oxygen in the water without harming aquatic creatures. It is also very safe for boats to cruise through, and its scope can cover the whole breadth and depth of the river. We hope that this technology can be applied to other rivers as well.

Compared to the abovementioned River Interceptor and Bubble Barrier, CLEAR RIVERS proposes a systemic solution that combines trash intercepting, cleaning, environmental education, improving public awareness, and recycling. CLEAR RIVERS uses devices that are likened to floating piers and intercepting cables to collect trash in rivers and around piers. The trash is then sorted and can be made into 3D printing filaments as well as remade into dock structures, modern-styled sofas, and hexagon bricks used in constructions. A water park that consists of floating islands can not only allow plants to grow, it can also attract birds and fish to inhabit there. This brings greenery to a metropolitan city like Rotterdam, and it is also the best example of directly showcasing to the public the results of cleaning marine debris.

Figure 5/ Floating islands made with recycled plastic waste from CLEAR RIVERS
Source/ CLEAR RIVERS

Conclusion

The issue of marine debris has inspired a great deal of self-reflection on the use of rare materials and the benefits of reusing resources. As a result, the Dutch government is swiftly transforming the country into a circular economy. This has blurred the lines between products, materials, and components by adding value and enhancing performance. The Dutch government is creating a virtuous cycle of sustainable development. The Netherlands now has 1,500 innovative circular economic initiatives in product design, business models, and technology, such as recycling plastic and turning them into furniture or construction materials, and even transforming recycled waste into floating island parks on the canal. The Netherlands has proven to the world that these measures are not only beneficial for the environment but also for the economy. Policies are used to establish the basic frameworks, and through incentives and easing regulations, the Netherlands are flourishing with all kinds of innovative ideas. In the future, more people and businesses need to support this cause and transform the Netherlands into a model for a circular economy, thereby accelerating global transformation and embracing sustainable development.

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The Ministry of Infrastructure and Water Management and Marine Policies in the Netherlands

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Keywords: Maritime transportion, Marine policy, Water management

The outward orientation of the Netherlands stems from its distinguished maritime history with its location at the mouth of the Rhine River, which has earned its name as "the Gateway to Europe." The Ministry of Infrastructure and Water Management (Ministry of I&W) has been instrumental in the development of maritime transportation in the Netherlands. Its main business includes maritime transportation and seaports, water management, and sailing and boating. The Dutch water transportation is well-connected between ports and the inland waterways, and the main objectives of maritime transportation and seaports are to ensure the safety of maritime transportation and to maintain the sustainability of ports. The Netherlands also has problems with territories below sea level or of river flooding. Therefore, water management services are required for flood control and ensuring adequate water supply. As for Taiwan's maritime industry, there are many development conditions similar to those of the Netherlands, such as limited land area and the externally oriented economy. Taiwan may use the experience of the Netherlands for reference by understanding the Dutch maritime policies. The Ministry of I&W and marine policy in the Netherlands are introduced in the article.

Ministry of Infrastructure and Water Management in the Netherlands

The Ministry of I&W in the Netherlands is committed to creating an efficient transportation network by railways, highways, waterways and airways, as well as effective water management to combat flooding and improve air and water quality [1]. There are four Directorates-General responsible for policy-making, including Directorate-General for Mobility, Directorate-General for Aviation and Maritime Affairs, Directorate-General for Water and Soil Affairs, and Directorate-General for the Environment and International Affairs. Additionally, there are the Rijkswaterstaat (RWS) for policy implementation, Human Environment and Transport Inspectorate (ILT) for statutory compliance, and the Netherlands Environmental Assessment Agency (PBL) and Royal Dutch Meteorological Institute (KNMI) are also the agencies under the Ministry [2].

I. Maritime Transportation and Seaports [3]

As a small country that has almost no natural resources, more than half of imports and exports in the Netherlands are transported by sea, which shows the importance of maritime transportation and ports to its economic development. Hence, the Ministry of I&W is committed to maintaining the safety of maritime transportation and ports along with planning for future development. In addition, the Dutch government continues to promote port sustainability measures to reduce pollution from ships. The related departments and subject scope of maritime transportation and seaports are introduced as follows.

i. **Related Departments:** The related departments under the Ministry of I&W include Directorate-General for Aviation and Maritime Affairs, Directorate-General for Mobility, Directorate-General for the Environment and International Affairs, Directorate-General for Water and Soil Affairs, and ILT .

ii. **Subject Scope:** The five main subjects are shown in Table 1.

Table 1/ The Subjects of Maritime Transportation and Seaports

Subject	Subject Description
International Maritime Agreements	Maritime issues are considered as an important facet for the Netherlands, having a voice in international organizations can attract attention from other countries. Therefore, the Netherlands has representatives in the following international organizations: International Maritime Organization (IMO); International Labour Organisation (ILO); European Maritime Safety Agency (EMSA); Working Party on Shipping of the Council of the European Union.
Enhancing Port Competitiveness	• Strengthening Seaport Trade: The main competition Dutch seaports face comes from other large seaports e.g. the port of Hamburg, German. Thus, the seaports must be attractive in cargo handling. • Rotterdam Mainport Development: Expanding Rotterdam to remain competitive. At the same time, the liveability of the Rhine Estuary region must be improved. • Improving Port Accessibility: Deepening and maintaining the depth of sea lanes, improving and expanding transport links with the hinterland, strengthening collaboration with knowledge-based industries and manufacturing industries in neighboring regions.
Maritime Safety and Security	• Preventing Terrorism: The Dutch government has incorporated the International Ship and Port Facility Security Code (ISPS Code) and Regulation (EC) No. 2004/725 security requirements into Schepenbesluit 2004 (Shipping Decree) and Havenbeveiligingswet (Port Security Act) for protection of maritime transportation and seaports against terrorism. • Combating Piracy: The Netherlands has become a party to the Regional Cooperation Agreement on Anti-Piracy in Asia (ReCAAP) in 2010. • Maritime Safety: The Dutch government has signed international maritime safety agreements and ensured to provide better maritime education and training.
Maritime Sustainability	• Combating the Harmful Effects of Ship Emissions: The content of low sulphur fuel oil shall not exceed 0.1% in the North Sea area since 2015. Ships shall not discharge waste at sea. In European ports, ships are obliged to turn over their waste and pay a waste treatment fee. • Ballast Water: Ballast Water Management Convention (BWM Convention) is an international convention adopted by the IMO in order to help prevent the spread of potentially harmful aquatic organisms and pathogens in ships' ballast water. • Fair and Safe Disposal of Ships: Only ship recycling companies that fulfill strict environmental and working conditions are allowed to dispose of ships.
Smart Shipping	Smart shipping refers to a greater degree of autonomy in navigation for ships, including on-board technologies, ports, and waterway design, with the following three advantages: • More Competitive: By obtaining more accurate navigational data, ships can utilize waterways more productively, reduce transport costs, and improve the competitiveness of inland shipping. • Safer Sailing: Smart shipping can reduce the possibility of accidents caused by human error, making work on ships and coastal waterways safer and easier to manage. • More Sustainable: With Smart Shipping technologies, ships can save bunkers for more sustainable sailing, such as using more precise environmental data to allow ships to adjust their speed to reduce bunker consumption.

Source/ Government of Netherlands (2021) [3]

II. Maritime transportion and seaports policies [4]

The "Dutch Maritime Strategy 2015~2025" proposed by the Ministry of I&W divides the maritime policy into 7 directions, of which the maritime transport and port policy covers the following 4 directions.

i. Trade: An Attractive Shipping Register

The Netherlands has an excellent business environment and a favorable tonnage tax scheme, making it a potential location for ship registration. The government organizes more efficient registration and certification for seagoing ships, so that the quality is comparable to that of other important maritime registers, including faster registration and certification procedures. A more flexible payment system is also provided.

ii. Accessibility: Chain Optimization and Nautical Services

The government and industry will continue to pursue seamless logistics and transportation network, as well as the integration of maritime transportation. The Dutch government provides navigation-related services and is committed to the development of offshore shipping. The government hopes to reduce the administrative burden of maritime transportation by optimizing the opportunities for offshore shipping between European countries, make the shipping environment friendlier, and improve the transportation links between ships, ports and hinterland.

iii. Safety and the Environment: Adequate Regulatory Framework
The government and industry are striving for a modern and appropriate international regulatory framework for safer, more environmentally friendly and sustainable development of shipping and ports in the Netherlands. The government will make efforts to implement new legislation promptly and establish a sound policy, implementation and enforcement chain. This policy covers environmental safety-related issues, such as restricting harmful ship emissions and regulating the safe disposal of ships.

iv. Communication: Establishing a Knowledge Program in Shipping
The proper execution and monitoring of maritime strategies require specific expertise. The Dutch government has not only established an agenda for seaport knowledge, but also pondered knowledge issues related to maritime strategies, and exchanged relevant knowledge with the overall maritime community.

In recent years, the proportion of national ships in the Taiwan fleet has not increased. According to statistics from UNCTAD in 2020, the proportion of national ships in Taiwan is only 14.14%, while in Dutch is 58.72% [5]. We can learn from the Netherlands and adjust our ship registration system in order to increase the proportion of national ships. In addition, it can be seen from customs statistics that almost all of Taiwan's imports and exports rely on shipping industry [6]. We can follow the Dutch policy, such as increasing the connection between the port and the hinterland to overcome the problem of limited land area, and maintaining or strengthening port facilities to enhance port accessibility and competitiveness. After all, the government can communicate with the maritime community more frequently to better understand and pay more attention to the development of maritime industry.

III. Water Management

More than half of the Dutch territory and two-thirds of economic activities are located in areas prone to flooding and at risk of inundation. These factors forced the Netherlands to face the safety of water management, especially in flood control and dam maintenance [7]. The Dutch water sector has a global reputation. The cooperation of experts from the government, expert institutes, industry and NGOs brings sustainable solutions to the world's greatest challenges [8]. The related departments and subject scope of water management are introduced as follows.

i. Related Departments: The responsibilities of related departments in water management are shown in Table 2.

Table 2/ The Responsibilities of Related Departments in Water Management

European level	
European Union: Legislation and regulation for water, floods and the environment	International River Basin Commissions: Cross-border water management
National level	
Ministry of Infrastructure and Water Management: Water, spatial planning and flood protection at national level	Rijkswaterstaat: Operation and maintenance of main water system
Provincial level	
Provinces: Integrated spatial and environmental planning, supervision of Regional Water Authorities (RWAs), groundwater regulation, and co-ordination with other regional policy areas	
Watershed level	**Municipal level**
District water boards: Operation and management of regional water systems, flood defense, water quality and water quantity, and wastewater transport and treatment	Municipalities: Local spatial planning, sewage collection and wastewater transport, urban drainage, and stormwater collection

Source/ Organisation for Economic Co-operation and Development (2014) [7]

As shown in Table 2, the Dutch authorities attach great importance to water management, and the responsibility of each unit is clearly defined. Internationally, it complies with European Union water legislation and international basin committee's legislation. Nationally, the Ministry of I&W of the Netherlands and RWS jointly plan the flood control and water system policies. The provincial and district water boards plan the water management measures within their areas.

ii. Subject Scope: RWS and the district water boards are in charged with water management in the Netherlands. They are responsible for ensuring a sufficient supply of water and protecting the country against floods [9]. The subject scope of them is shown in Table 3.

Table 3/ The Subject Scope of Water Management Departments

Department	Area	Responsible Description
Rijkswaterstaat	Major waters, such as the sea and the rivers	• Issue flood and rainstorm warnings for the government • Maintain dikes and dams • Deepen the floodplain and build secondary channels
District water boards	Regional waters, such as waterways and canals	• Ensure water quality • Prevent flooding and ensure that farmers have sufficient water resources • Responsible for wastewater purification

Source/ Government of Netherlands (2021) [9]

As shown in Table 3, the Ministry of I&W of the Netherlands are divided into central and local departments. RWS aims at overall national security and construction, while the district water boards is responsible for the management of local water resources.

IV. Water Management policies [8]

i. National Water Plan 2016~2021

- Draft policies for Dutch's flood risk management and freshwater supply.
- Identify strategies for flood-prone areas, such as the Rhine-Meuse delta and the coastal area.
- Review the optimal way to accommodate water in spatial planning in the Netherlands, and its costs.

ii. Administrative Agreement on Water Affairs (Bestuursakkoord Water)

The Dutch central government, provincial authorities, municipalities, district water boards and water companies signed an agreement on Water Affairs (Bestuursakkoord Water) in 2011. This agreement stipulates a total funding of 750 million euros for the High-Water Protection Program (HWPP) until 2020 for water systems and water supply chains. The HWPP targets dams and dikes that do not meet safety standards, yet have not been included in other programs, for enhanced flood protection to preserve the ocean and prevent high water levels in rivers.

iii. Value Water Initiative

In April 2016, the United Nations and the World Bank convened a High-Level Panel on Water (HLPW) to advocate for a holistic and collaborative approach to the development and management of water resources with improved water and sanitation-related services. In 2019, the Netherlands launched the Valuing Water Initiative (VWI). The initiative demonstrates the implementation of the United Nations Valuing Water Principles, with the aims of systemically reforming the way water is valued in policy, practice, finance and behavior, and encouraging others to follow suit.

Taiwan also faces the potential threat of flooding caused by heavy rains and typhoons, which will cause damage to flood protection and drainage facilities every year. Refer to the Netherlands, we can promote cooperation between the government and experts from industry or academia to find the most suitable solutions for Taiwan.

Sailing and boating [10]

The Dutch government regulates sailing permits and registration regulations for watercrafts, such as sailboats and boats. There are four main sections:

I. **Obtaining a yacht license:** If you want to sail a yacht with a hull length of 25 to 40 meters, you need to take an exam to obtain a yacht license. This license does not allow commercial use of the ship. Groot Pleziervaartbewijs II is valid for navigation in all inland waterways and is the International Certificate of Competence for yachts in inland and coastal waters.

II. **Registration of speedboats, water scooters or jet skis:** Speedboats, water scooters, and jet skis must be registered in the Netherlands before sailing in inland waters. The registration certificate is only valid in Dutch inland waters. If you wish to sail abroad, you shall check whether the country accepts the Dutch registration certificate.

III. **Obtaining a small license for speedboats or pleasure boats:** A small license is required if you want to sail a speedboat under 20 meters and over 20 km/hour, or a pleasure boat 15 to 25 meters long. You must pass the exam of CBR (Central Bureau Rijvaardigheidsbewijzen) to obtain this license.

IV. **Application to Kadaster for registration of boats:** The registration of a boat can be done in the public registry of Kadaster. This applies to houseboats, sailboats and other yachts. After registration, Kadaster will affix a registration number, also known as a brand mark, to the boat. This branding can protect the boat from theft.

Taiwan's 2020 National Ocean Policy White Paper states that the government is formulating policies to promote ocean tourism [11]. Water sports is one of the fun activities to do when visiting the Netherlands. We can learn from Dutch's detailed legislation on watercrafts, including certification requirements, ship registration and navigation regulations in different waters. Regarding the development of ocean tourism, Taiwan still has a lot to learn from the Netherlands.

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Tank Testing and Demonstration of Space@Sea Floating Island

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Keywords: floating island, tank testing, Maritime Research Institute Netherlands

Statistics [1] show that the majority of the world population resides in inshore coastal areas. However, as sea levels rise with global warming, in the near future, the limited amount of littoral land will have to be redistributed or drastically altered in how it's used. Hence, researchers are becoming increasingly interested in the possibility of the development of ocean space. In addition, offshore development is quickly shifting from the conventional offshore oil and gas industry to applications such as renewable energy, aquaculture, transportation hubs, tourism, airports, and cities [2]. Historically, development activities that have transitioned from land to sea were usually achieved through the use of offshore platforms or artificially created land. Although the concept of a floating island that fulfills multiple purposes has been proposed, so far there has not been any examples with tangible results. In fact, many technical barriers for large floating islands still exist. For example, when large numbers of floating modules are joined to form an island, the interactions between them can be very complicated. In light of this, the European Union commenced the research project named Space@Sea in the Horizon 2020 research program in November 2017, appointing 17 collaborating partners. These partners include: Maritime Research Institute Netherlands, DeltaSync, DST, Nemos, Delft University of Technology, Mocean Offshore, TU Hamburg Harburg, Bluewater, University of Rostock, Gicon-Grossmann, Wageningen University & Research, University Duisburg-Essen, TU Graz, Waterstudio, Icepronav, Val Fou and GeoSea. The goal of the project is to develop standardized floating modules and build affordable large floating islands that are environmentally sustainable and have a low ecological impact. This article will introduce the floating island hydraulic model experiments conducted by Space@Sea in the tank at the Maritime Research Institute Netherlands (MARIN), and describe the results of the experiments.

Scope of Floating Island Tank Tests

The Space@Sea project also uses a modular concept. The overall structure is shown in Figure 1. There are 4 clusters: the technical/non-technical cluster (business model, technical challenges and environmental effects) in WP 1-5, the application scenario cluster in WP 6-9, the module integration and demonstration cluster, WP 10, and the cluster that deals with management, dissemination and implementation in WP 11-12. Among them, the four application scenarios for floating islands include Energyhub@Sea, Living@Sea, Farming@Sea, and Transport&Logistics@Sea. They are each introduced below.

- The design of the Energyhub@Sea component (WP 6 of Figure 1) includes the use of the relative motion between floating modules to produce renewable energy. It also utilizes the floating modules to create developmental space for renewable energy sources such as solar power and wind power. The goal of this work item is the development of a wave energy converter and to evaluate the motion response that weakened wave energy would have on inner floating modules. Additionally, services such as the storage of renewable energy and electric power transmission are evaluation items as well.

- The philosophy of Living@Sea (WP 7 of Figure 1) is that jobs at sea will also attract people to live at sea. Similar needs have already appeared in the maintenance work of offshore renewable energy industries. Due to the high cost of sending technicians to complete missions at sea, the demand for hotel space at sea has emerged. The early stages of the project will aim at housing technicians, but it will gradually expand to include family residences and eventually larger building complexes and cities.

- Farming@Sea (WP 8 of Figure 1) will develop agriculture components that specialize in aquaculture. The goal is not only to maintain the self-sustainability of the floating island, but also to develop technology that promotes the production of aquaculture and biomass energy. Furthermore, aquaculture further away from the shore will become more feasible.

- Transport&Logistics@Sea (WP 9 of Figure 1) will develop offshore hub components. This is to solve the issue of some harbors no longer having the capacity for expansion despite the constantly rising volume of maritime transport. For harbor cities with limited expansion space such as Constanta, Barcelona, and Gibraltar, having offshore hub stations is their only opportunity to grow. Moreover, for ports like Hamburg and Antwerp, offshore logistics hubs provide the possibility to increase port throughput, while also reducing the necessity of having large vessels navigate through narrow rivers.

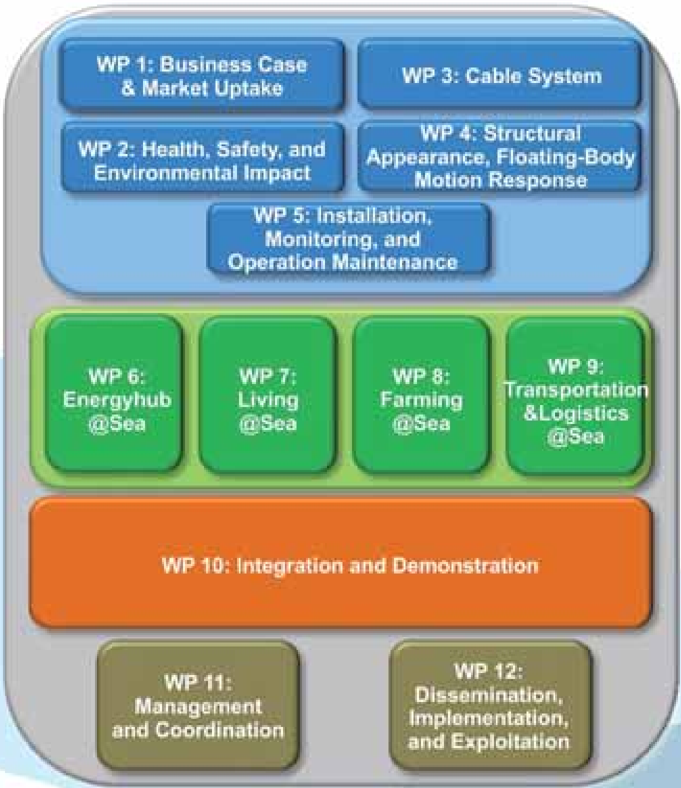

Figure 1/ Project Framework of Space@Sea and its subprojects at each WP
Source/ Flikkema M. and Waals O. [2]

In order to further evaluate the hydraulic response characteristics when the floating island integrates the 4 application modules mentioned above and to demonstrate the results, in the Offshore Basin within their facility, MARIN conducted testing on a 1:60 scale. These tests consisted of multiple subsystems, including 73 floating island modules, 260 connector modules, 46 cables, and one berthed cargo ship. Test items included calibration testing of weight proportion and climate environment (including extreme conditions of the 100-year recurrence interval), and static load tests such as cable restoring force and free decay testing. The results can be used to examine some of its hydraulic characteristic and provide data for simulation calibration.

In addition, in the seakeeping quality test, measurement items included the flow speed at each position, wave height, the 6-axis motion of the modules and the cargo ship, the 6-axis load of the cables and connectors, and the effects the wave energy convertor and green water had on the deck. The floating island testing layout is shown in Figure 2. It's worth noting that in order to reduce the total variance, the variance of each individual module had to be minimized (for example, the mass, center of gravity, and the draft). Hence, during the testing, none of the modules had structures mounted above; only during public display will these structures be set up.

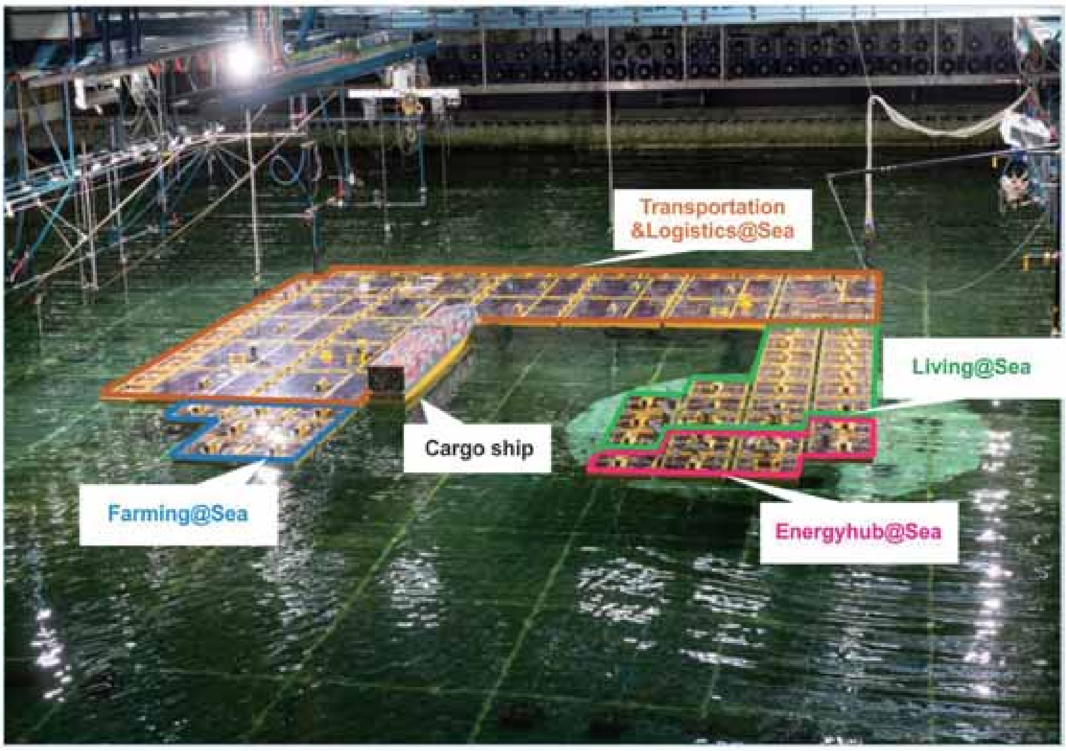

Figure 2/ Photo of floating island tank testing in Holland MARIN. The pink part is the energy center (level 6), the green part is living space (level 7), the blue part is the agriculture center (level 8), and the orange part is transportation and logistics (level 9)
Source/ https://spaceatsea-project.eu/images/d10.4_part1.pdf

Experiment Equipment and Module Introduction

In this section, the MARIN testing tank, floating modules, connector, cable system, and berthed ship will be introduced in turn.

I. Testing Tank
The MARIN wave generating basin (46 x 36 m) has a movable floor (36.35 x 31.6 m) that allows partial adjustment of the depth. The maximum depth is 10.2 m; in addition, there is a well in the center of the basin that can reach a maximum of 30 m. The current generator comprises six individual circulation channels and can generate an even flow field up to the depth of 10.2 m. The wave generator is made up of 200 individual flaps. By individually controlling its frequency and stroke, it can generate long-crested irregular waves, directional propagating irregular waves, and combinations of waves and surges.

II. Floating Modules
The floating island is made up of three different types of modules, including square modules with original sizes of 45 x 45 m and 95 x 95 m, and a wave energy converter (WEC) module with the original size of 26.58 x 45 m. The height of the square modules are all 11 m (shown in Figure 3a), with a draft of 8

m. The height of the WEC modules is 4 m and the draft is 2 m (shown in Figure 3b). The bottom and sides of the downscaled square module model are colored yellow, in order to enhance their visibility in photos and videos. The upper cover is made with a transparent acrylic material to allow visual examination of leakage during the testing process. Additionally, torsion testing showed that, by using wooden slab stiffeners on the inner sides of the module to avoid module deformation, the average deformation of the diagonal measurement of the module was only 0.157 mm/kg.

III. Connectors

Other subprojects of Space@Sea have already analyzed different connector designs. For the tank testing, MARIN chose to use the "Graz-connector". For its complete design and characteristics, refer to [3]. The connector is made of fender and, as shown in Figure 3a, through the tension of the cables, pre-compression of the fender can be maintained. In the tank testing, appropriate springs are used to simulate the effects of the connecting cables.

IV. Cables

The catenary cable design is from the third subproject of Space@Sea. It is suitable for environments with depths of about 100 m. The original length of the cable is 436 m and it weighs 798 kg/m. The gravity anchor blocks used in the tank testing have stainless steel chains with a diameter of 32 mm and weight of 50 kg (as shown in Figure 3c). Load sensors were installed at some of the shackles of the cables.

V. Berthed ship

To study the interactions between the berthed ship and the floating island, MARIN used the existing M10128 cargo ship model (shown in Figure 3d) to simulate the ship being berthed using two sets of connectors, and analyzed the ship motion and capacity of the connectors.

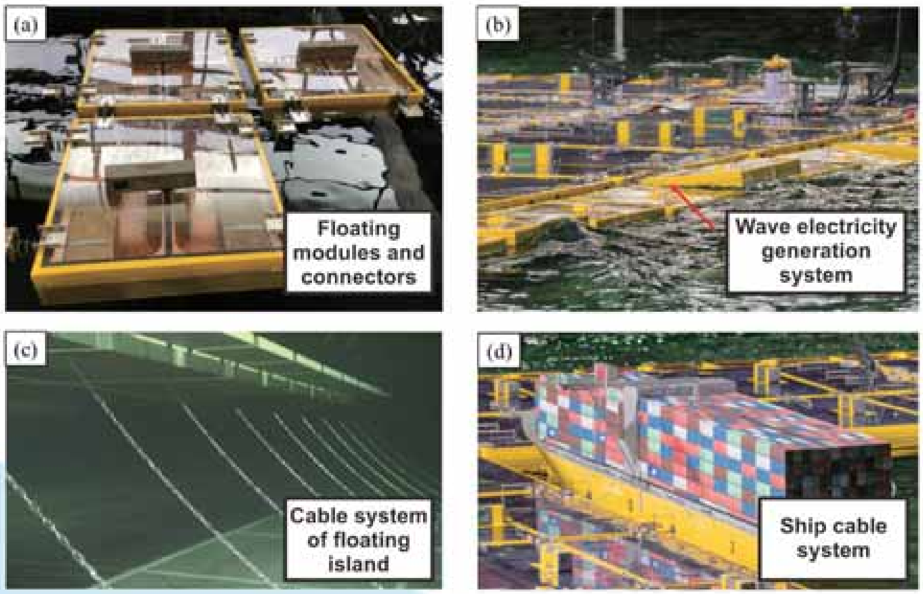

Figure 3/ (a) Square floating modules and connectors; (b) Wave electricity generation system module; (c) Cable system of floating island; (d) Ship cable system
Source/ https://spaceatsea-project.eu/images/d10.4_part1.pdf

Results

Overall, the motion behavior of the floating island that comprised multiple square modules did not differ much from that of the original predicted simulation. Excerpts of important experiment results are as follows:

The results of cable tension and the reaction curve of floating island displacement from the static load testing corresponded with the simulation, which means that the scale of the cables and testing installation layout meet the requirements of the original size. The results of the free decay testing show that the floating island displays a typical beating pattern. This mechanism results from multiple similar modes of resonance, which is responsible for the oscillation phenomenon during late stages of the free decay. The natural frequency of the surge, sway, and yaw were between 155 s and 180 s.

When under the effect of a single current, the floating island exhibited stable draft and motion. When under the effect of wave action, all surge, sway, and yaw motion responses were at low frequencies; almost no motion responses were generated by waves or higher frequencies. The most probable maximum (MPM) angle of pitch of each floating module was recorded. These results show that modules facing the waves can reduce the wave diffraction effect, resulting in relatively stable side modules.

As for the connectors, since the fenders were able to be maintained in a compressed state throughout the effects of the current and waves, the designated pretension of the cables were sufficient. Additionally, when comparing incident angles, an incident angle at 225 degrees generated the greatest shear force on the fenders. Also, the maximum tension on the cables under all testing conditions were below the fracture strength of the material. The overall safety factor was greater than two.

Under storm condition, significant green water effects occurred on the wave energy convertor module, and some of the water body overflowed to the rear modules, as shown in Figure 3b. In the future, further evaluation of the green water impact force, overflowing volume, and installation of appropriate barriers during the operation of the wave energy convertor would be necessary. For the berthed ship, since the berth unit was within the shielded inner port of the floating island, the water level and the cargo ship appeared to be rather stable.

Conclusions

The aim of the Space@Sea project is to develop a standardized and cost-efficient modularized island that has minimal ecological impact and provides sustainable affordable space for living and working. Overall, after tank testing the concept of the modularized floating island, the hydraulic response of the overall structure and each module corresponded with the calculated data, proving that the modularized technology is feasible. When MARIN displayed the Space@Sea modularized floating island in October 2020 [4], it included upper layer structure models on each module (such as cranes, cargo harbors, photovoltaics, wind power generators, and residential houses), to demonstrate the four different application scenarios. In the future, the project will continue to solve technical issues that were revealed during the testing process, such as protection methods against the green water effect, optimization of the module geometry in terms of economy and technology, and cable schemes at different depths.

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A Peek into the North Sea Agreement: Taiwan Gains Insights from the Netherlands' Experiences

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Translated by Linguitronics
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The Executive Yuan promulgated the "Thousand Wind Turbines Project" [1] and the "Four-year Wind Power Promotion Plan" in 2012 and 2017 respectively. The Executive Yuan implemented the "First Onshore then Offshore Plan" and the three-phase strategy "Demonstration Incentive Program, Zones of Potential, and Zonal Development" to promote offshore wind power gradually [2]. Some results have successfully been accomplished. In the first phase, the offshore demonstration project (128MW) first started commercial operations 2019, while the Taiwan Power Company demonstration project (109.2MW) also started commercial operations in 2021 [3]. In the second phase, 9 developers and 14 wind farms (a total of 5.5GW) were licensed through capability review and bidding process and are scheduled to start commercial operations before 2025 [3]. The Taiwan government is now drafting the third phase, zonal development. We plan to generate at least 1GW annually from 2026 to 2035 [4]. However, due to complex spatial competition among different issues such as ecology, aviation safety, national defense, fishery, and marine safety, the path to reaching a consensus is filled with obstacles. Therefore, this article will introduce the experiences of stakeholders in the Netherlands' negotiation for offshore wind power—the North Sea Agreement (NSA)—hoping to serve as a reference for our own negotiations in the use of offshore regions.

Figure 1/ Buitenhaven fishing port is situated near the Afsluitdijk dam, which is at the end of the province of North Holland. Around the port is a shallow wetland, Waddenzee, which connects to the North Sea
Image by Po-Cheng Huang

The Background and Challenges of the NSA

The North Sea, which is in north western Europe, is not only an important ecological system but also a crucial source for a variety of foods. Furthermore, it is also where shipping, recreation, military training and energy mining take place. As climate change has already caused significant impacts on marine ecology, the Dutch government aims to replace fossil fuel with renewable energy in accordance with the Paris Climate Agreement on reducing carbon emissions. The government also strives to strike a balance between environmental impacts and effective implementation. The NSA is the initial result of weighing the interests between the Dutch government and other stakeholders.

The NSA focuses on three cohesive challenges—nature transition, food transition and energy transition. The goal of the NSA is to draft a comprehensive long-term ocean development policy. In terms of nature transition, according to the European Union's Marine Strategy Framework Directive [5]; when dividing sea areas, the impact of the activity on marine ecology should be considered. As for food transition, economic activities on the North Sea will have an impact on the sustainable development feasibility of the fishery industry, which leads to pressure on the Dutch to transform their fishery industry. Lastly, for energy transition, the Dutch government announced the National Climate Agreement in 2019, listing the North Sea as a pivotal area for promoting renewable energy [6]. To strike a balance between the ecological system and different economic activities at sea, the choice made to strike a balance between marine ecological plans and energy technology must be adjusted [7].

Initiating a Dialogue: The Role of OFL and Stakeholder Negotiation Mechanism

Throughout history, the Netherlands has fought with the sea for land. Their social systems were derived from long-term planning and consensus, which were evolved from the country's water governance experience. Currently, the Dutch government assists the public sector in implementing forward-looking research and activities by setting up committees and planning agency, hoping to establish a governance model that can effectively integrate different stakeholder's opinions [8]. With regards to the North Sea issue, the main responsible authority is the Ministry of Infrastructure and Water Management (Ministry of I&W). The Ministry of I&W and related departments consulted with the Physical Environment Consultative Council (OFL) in 2019 to lead and initiate the North Sea Dialogue [7][9]. The mission of the OFL is to provide an interactive stakeholder platform for the government and people through designing a collaboration and governance model. The OFL establishes a working plan according to the issues raised by the government and society annually. Issues raised include energy, climate, agriculture and water security [10].

Regarding the negotiation mechanism of North Sea stakeholders, OFL hosts a dialogue meeting for six consecutive days after having a list of stakeholders. It will then arrange two meetings every three weeks for 18 months. One meeting will focus on specific issues and invite experts and scholars while the other meeting will allow more participants to share their positions and views. After this, the OFL will hold an online survey and an offline meeting for all citizens that lasts for two weeks to collect public opinion. Lastly, OFL will hold a two-day general meeting. In addition to stakeholders, the Council will also present public opinion to reach a consensus [9].

Table 1/ Participants at the North Sea Dialogue

Sector	Organization	Signed the final agreement before 2020/6/19
Energy	Netherlands Oil and Gas Exploration and Production Association (NOGEPA)	○
	European Wind Energy Association (EWEA)	○
	The European Business and Innovation Centre Network (EBN)	○
	TenneT, an electricity transmission system company	○
Fishery	Visserbond	X
	VisNed	X
Environmental Protection	Dutch Birdlife International	○
	Nature & Environment Foundation	○
	North Sea Foundation	○
	World Wildlife Fund - Netherlands	○
Public Sector	Ministry of Agriculture, Nature and Food Quality (LNV)	○
	Ministry of Economic Affairs and Climate Policy (Ministry of EZK)	○
	Ministry of Infrastructure and Water Management (Ministry of I&W)	○

Source/ de Koning et al. (2021)

Key Consensus in the NSA

The OFL invited the Dutch government and stakeholders to discuss and negotiate together, which resulted in the NSA. All parties have reached extremely meaningful, feasible and visionary consensus in spheres such as regulation, issues, finance, technology, research, and implementation. The key points are as follows [7]:

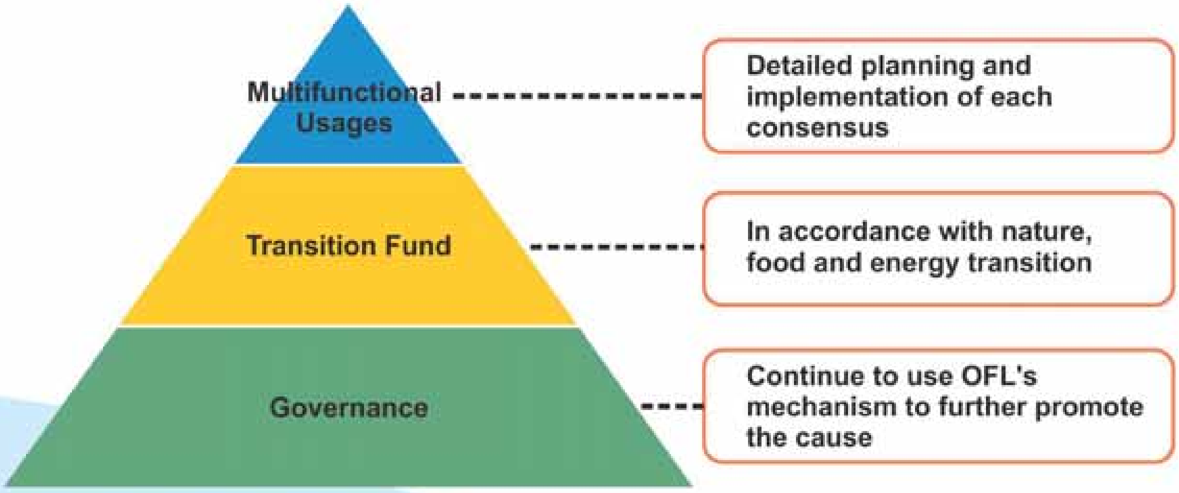

Figure 2/ Key Consensus Framework in the NSA
Image by Li-Yun Tsao

I. Governance

The Dutch government and stakeholders agreed that the NSA will be adopted for the initial steps taken to gradually promote future formal policies or the legalization under the existing international law framework. All agreed to adopt the negotiation mechanism established by the OFL. With the North Sea Consultation as a means for future negotiations and promotion platform, it will allow governance to be the foundation for consensus.

II. Transition Fund

Taking the requirements of nature, food and energy transition plans into consideration, establishing a transition fund became a crucial consensus. Details include fund application criteria (criteria that applies and do not apply), establishment schedule, monitoring governance, sum proportion etc. The fund will pay for compensation and serve as a buffer that is independent from other financial source and existing budgets.

III. Multifunctional Usages

The Dutch government and related stakeholders all agree that the North Sea is an area of common interest. They all hope to maximize the benefits of using the resources within the limited ocean space. All allow for non-exclusive competition and collaboration, and will accept diversity and find the best solutions. The Dutch government and related stakeholders propose to make plans based on the specific purposes of using resources (including fishery, aquaculture, national defense, sand mining, aviation safety, sea bed cables, oil and gas, scientific research, sea activity monitoring, and offshore wind power area selection) as well as the possibilities of future coexistence via the Areas Passport plan.

Conclusions

The OFL was initially the coordinating factor of the NSA, bringing related government departments and stakeholders into dialogues to reach consensus. The crucial points of their consensus are: "the governance model of the North Sea will follow the OFL negotiation mechanism in the future", "the NSA is just the initiating phase towards formal policies and legitimization", "establishment of the transition fund is necessary" and "diverse usage of the sea area has solved collaboration and competition issues". The Dutch OFL negotiation mechanism has evidently become an important driving force for achieving the NSA. Taiwan's Ocean Affairs Council was established in 2018, but has yet to become a coordinator in sea area planning issues. If we want third party academic or research institutions to serve as the negotiator, we can refer to the OFL model. Weighing the interests of stakeholders and reaching a consensus through systematic negotiation are beneficial to accelerating offshore energy policies.

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