The Legislation Recommendation and Promotion of Multifunctional Ocean Space Usage: Combine Floating PV Installations at Offshore Wind Farm

APEC Energy Working Group

February 2025

Asia-Pacific Economic Cooperation

The Legislation Recommendation and Promotion of Multifunctional Ocean Space Usage:
Combine Floating PV Installations at Offshore Wind Farm

APEC Energy Working Group

February 2025

APEC Project: EWG 13 2021A

Authored by
Yiyuan William Su
Nate Maynard
Keng-Tung Wu

Produced by
Chung Hsing University
Chinese Taipei
wukt@nchu.edu.tw

For
Asia-Pacific Economic Cooperation Secretariat
35 Heng Mui Keng Terrace
Singapore 119616
Tel: (65) 68919 600
Fax: (65) 68919 690
Email: info@apec.org
Website: www.apec.org

APEC#225-RE-01.2

CONTENT

Chapter 1
Introduction

The adoption of renewable energy in place of fossil fuel combustion can reduce carbon dioxide (CO_2) emissions into the atmosphere and lessen human impact on the environment. Therefore, in recent decades, natural energy sources such as solar, wind, and hydropower have gradually replaced fossil fuels. Since the implementation of the Kyoto Protocol in 1997, renewable energies have become an integral part of energy strategies and policies among the Contracting Parties.

At present, the renewable energy deployment involves onshore installations distributed across economy's territories. However, smaller economies, in particular, are projected to encounter escalating land-use constraints that could hinder the continued expansion of renewable energy usage. Consequently, it is imperative for governmental bodies to proactively identify and secure alternative locations suitable for the establishment of future renewable energy infrastructure. The maritime space area has the highest potential for providing an increased capacity for electricity generation.

A central focus of maritime spatial planning analysis is the establishment of offshore wind farms and the multifaceted utilization of marine environments. This includes the exploration and potential integration of offshore solar photovoltaic (PV) systems. Given that renewable energy technologies derive electricity from the conversion of natural processes, it is essential for economy's policies to prioritize and incentivize research and development within this domain.

Climate change and the escalating global energy crisis have compelled European economies and the United States to explore unconventional energy sources. The ocean, which receives 70% of the sun's global primary energy resource, presents a vast potential that has remained largely untapped due to technological limitations (Pedersen, 2015). However, recent advancements in offshore wind technology, including the growing viability of floating offshore wind installations, coupled with the established fossil fuel-based offshore extraction industry, have prompted renewable energy developers and governments to turn their attention to the ocean as a potential solution to energy challenges.

Hybrid renewable energy projects and offshore hybrid energy storage systems, once deemed prohibitively expensive to construct and operate, have begun to emerge across the European Union (EU). Concurrently, supportive legislation for their development has been introduced in the United Kingdom (UK) and the United States (McTiernan & Sharman, 2020). By examining the policies of these four distinct yet similar economies, valuable insights can be gleaned to inform the optimal development of offshore hybrid energy throughout APEC economies. This analysis aims to identify common legislative areas that can serve as a foundation for promoting and advancing offshore hybrid energy initiatives in the APEC region.

Due to limited land availability, several APEC economies have deployed offshore wind turbines and floating photovoltaic (PV) panels to optimize space utilization. However, the areas between offshore wind turbines, as well as the vertical space below the blades and above the ocean surface, are often underutilized and remain vacant. These spaces present opportunities for the installation of additional renewable energy facilities, such as mid-sized wind turbines or floating PV panels interspersed among the existing towers. For APEC economies lacking suitable natural conditions for wind farms, offshore floating PV panels can serve as an alternative means of generating renewable energy. This approach would enhance both the utilization of ocean space and the generation of green electricity. This proposal for "multi-functional usage of ocean space" advocates for sustainable energy development by integrating offshore wind turbines with floating PV panels on the open territorial sea surface, thereby connecting to the grid system. This hybrid approach to renewable energy sources can bolster domestic energy security and reduce carbon intensity. It not only fosters the expansion of renewable power generation but also drives innovation in renewable energy technologies. Furthermore, it stimulates economic development and application, leading to a reduction in carbon dioxide (CO_2) emissions, the production of green energy, and the empowerment of local communities towards sustainability.

Currently, the majority of developing economies within the APEC region are experiencing significant land pressures due to population growth, economic development demands, and renewable energy development policies. To address this land scarcity, the exploration of the ocean surface within territorial seas could provide additional space for promoting renewable energy development. However, most APEC economies lack comprehensive regulations to manage ocean spaces, thereby hindering the integration of new technologies and the participation of both public and private sector stakeholders. While some economies have separate regulations governing activities on the ocean surface and within their territorial air space, they are generally unprepared to regulate mixed-space usage.

This proposal involves conducting legal research on the multi-functional use of ocean space through comparative legal studies, encompassing relevant domestic and international ocean management regulations and treaties. The aim is to identify and confirm the legal frameworks governing the usage of ocean and air space. To enhance capacity-building efforts, the proposal includes organizing a workshop to facilitate networking and collaboration in support of this low-carbon strategy. Participants will have the opportunity to engage in face-to-face interactions, exchange domestic legal research on ocean space management, and share knowledge in related fields such as floating PV technology, environmental science, and international law. This initiative seeks to improve access to affordable, sustainable, reliable, and clean energy within the APEC region.

Chapter 2
Defining the Potential of Hybrid Marine Energy

A variety of combinations and nomenclature exists for offshore renewable energy projects combining multiple energy or even industrial assets. Four broad categories emerge from literature. Hybrid offshore energy systems as defined by the European Commission are hybrid assets combine offshore renewables with transmission, most commonly seen as offshore wind projects with transmission or storage attached (European Commission, 2019). Projects that combine offshore renewable generation, such as solar and wind, or wind and tidal, are often defined as combined marine renewable energy (CMRE) projects (López et al., 2020). Multi-use platforms include activities beyond energy such as aquaculture or hydrogen gas production, with pilot projects adding on diverse activities at sea (Xylia et al., 2023). Increasingly, economies in the EU particularly around the North Sea are exploring multi-use platforms that cover energy generation and transmission along with other activities such as fishing or oil extraction (Legorburu et al., 2018; van Den Burg et al., 2020). The potential for floating factories and offshore industrial parks remains at the planning stage, most commercially viable projects revolve around offshore wind projects either hybrid or pilot projects with combined solar. Looking ahead, these projects will grow in viability due to decreasing costs already seen with both offshore wind and floating solar.

Type	Offshore Wind	Electricity Storage	Electricity Transmission	Floating Solar	Aquaculture
Hybrid Offshore Energy System	Yes	Yes	Yes	No	No
Combined Marine Renewable Energy	Yes	Yes	Yes	Yes	No
Multi-Use Platform	Yes	Yes	Yes	Yes	Yes
Energy Island	No	Yes	Yes	No	No

Given the size of the ocean, the excessive costs of development of maritime projects, and the strong presence of federal level legislation in most economies, any CMRE projects need to be fully studied and piloted before reaching a commercial level. Until recently, development and technology barriers for floating solar made this unrealistic, despite floating solar sites operating at various scales since at least 2014 (Kumar et al, 2015). Offshore wind does not have the same challenges. For this research, only regulations around hybrid offshore wind and solar, renewable energy (RE) transmission, and/or battery projects were considered due to the maturity and near-term commercial viability of those systems. The advantages of combining solar and wind provide more immediate benefits than other configurations.

2.1 Advantages of Combined Systems

One study modeling hybrid energy generation found strong electricity and financial benefits, with a combined wind and solar farm producing seven times more energy than a traditional standalone offshore wind farm due to a 68% reduction in power output variability. By smoothing the energy output increasing reliability and thus actual energy utilization (López et al., 2020)

Initial modeling studies of combined solar and wind projects found that an offshore PV plant generating 1 GWh of electricity could be 2-11 smaller than a typical offshore wind park. This study found that there were decreasing returns on including solar panels within a wind-park due to capacity factor and cost. Offshore solar can have 13% higher capacity than land-based systems due to the cooling effects of water on the panels (Golroodbari and van Sark (2020). Other studies explore the benefits in more detail, but for this research the advantage of combined solar and wind from economy level renewable energy targets and the existing maintenance required for offshore wind already. Installing solar panels beneath wind turbines thus becomes low risk as long as the technology continues to decrease in cost and improve in reliability.

Hybrid projects offer a promising solution, combining offshore wind generation with transmission capabilities, without necessarily incorporating solar or storage components on-site. In the European context, these hybrid projects present several advantages. First, by establishing dual-market linkages, they create offtake opportunities for excess energy, thereby enhancing the overall system's efficiency. Additionally, they facilitate capital expenditure (CAPEX) savings by eliminating the need for separate transmission and grid connection infrastructure for future offshore projects. Furthermore, hybrid projects reduce the requirement for connection points, streamlining the integration process. Notably, they also contribute to smoothing out supply and demand fluctuations, ensuring a more stable and reliable energy supply (Orsted, 2024). Few studies exist quantifying the costs of these projects but research from developers and initial modeling proves encouraging.

Regarding cost, the most expensive aspect of an offshore wind site is seldom the cost of the turbines. Instead, Wind turbines cost on average 30% of the total project, with other costs coming from on-going maintenance, planning, and site development (Pryor et al., 2021). Since many of the costs for offshore wind revolve around grid connection, site planning, and maintenance, these could be avoided for a floating solar project or built into those costs, giving developers more energy for already required planning and development work. But can these types of energy work well with other uses?

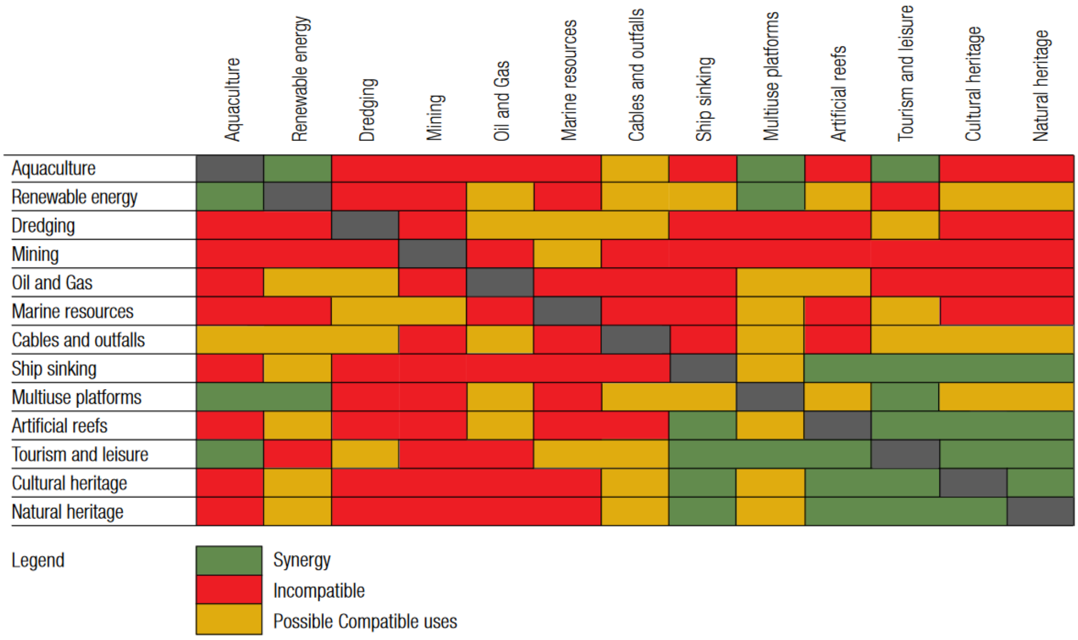


Figure 1 O'Hagan, Anne Marie. 2020 State of the Science Report, Chapter 11: Marine Spatial Planning and Marine Renewable Energy. United States: N. p., 2020. Web. doi:10.2172/1633204

Offshore solar energy has a special ability to be installed under and between offshore wind turbines and provides its real strength. According to analysis from Dutch researchers modeling the impacts of collocating floating solar and wind, a typical rigid solar panel has an average efficiency of 23%, equating to 230 MWp/km^2. Accounting for components like walkways that partially block sunlight, a typical 9.1 MW OFPV plant requires up to 0.05 km^2 of solar panel area. With surrounding mooring lines and safety zones, the total area covers around 0.39 km^2. In contrast, offshore wind has an energy density of only 8.6 MWp/km^2 due to the spaces between turbines, safe channel, and the standard efficiency of offshore wind electricity production (Schneider et al, 2023). This initial research suggests that due to the efficiency of offshore PV, even in less sunny places, there is plenty of energy potential to be captured between wind turbines.

This spatial advantage becomes clear when looking at marine spatial planning (MSP) processes. States repeatedly identify marine renewables being compatible with aquaculture, multi-use platforms, and having compatibility issues with oil and gas, artificial reefs, cultural heritage, and natural resources. Dredging, oil and gas, and tourism are not compatible (O'Hagan, 2020). Since most states can lump together offshore renewables in a planning process, this means many types of existing planning and development do not need to be repeated by adding solar. When reviewing the environmental impacts and current legislation around CMRE, there is both a lack of data and a lack of initial signs of a relatively high environmental impact.

While the environmental impacts of offshore wind are well studied, the impacts of other types of CMRE are less studied and like wind are often assumed to be fairly benign when compared with other types of marine resource utilization (Galparsoro et al., 2022). Since in the review no developers or regulators cited concerns around environmental impact assessments (EIAs) this research did not explore those impacts further, instead the opposite has occurred with new amendments from the

EU to legislation that encourage states to pass RE projects under a basis of assumed benefit.

A combined offshore wind, solar, and battery farm is not only possible it has been modeled in the EU and UK through various multi-lateral development and research schemes (Van Der Zant et al., 2024). Underpinning this development across all these regions are robust marine spatial management plans (MSP) ratified across the EU and in the UK. This defining and mapping of ocean uses implicitly created opportunities for hybrid energy, as regions of the seascape were already mapped for offshore wind, presumably offshore solar would pass a similar challenge although research is limited to one real world site study(Vlaswinkel et al., 2023). While the data may not be enough for researchers, it is not stopping governments from approving projects.

To understand the legal frameworks around the development of marine hybrid energy, this research reviews the legislative frameworks covering EU level legislation, state level legislation and projects in Belgium, the Netherlands, and the UK. Additional review of the Untied States (US) is conducted to test initial assumptions around MSP and renewable targets providing adequate framework. Three criteria: MSP planning documents, offshore energy targets, and operational projects were analyzed for this research to understand what legislative and policy factors led to robust support for CMRE development in order to help economies within APEC who seek to develop their marine energy resources.

Chapter 3.
The Renewable Energy Policies Among APEC Member Economics

3.1 Chinese Taipei Renewable Energy and Offshore Wind Power Development Policy

Article 6 of the Renewable Energy Development Act of 2009 stated the target of renewable energy installation capacity shall reach 20% of total power generation (27 GW) by 2025, and 60%~70% by 2050. However, due to lagging development progress, this goal may need to be postponed to 2026 or 2027 to be achieved.

The "Renewable Energy Development Plan"[1] of 2015 projected that the capacity of fixed-base offshore wind power installations would range from 2.03 GW to 2.43 GW by 2024, and reach 4 GW by 2025. In 2022, the government further expanded these targets, aiming for 13 GW by 2030 and 15 GW by 2035, with an ultimate goal of achieving 55 GW by 2050. The development of floating offshore wind power is also included in the Plan, with an estimated target of 9 GW between 2026

[1] Executive Yuan, Fully promote offshore wind power - build Chinese Taipei into an Asian offshore wind power technology industry cluster. June 13, 2019. Available at https://www.ey.gov.tw/Page/5A8A0CB5B41DA11E/9eebb9b8-490b-4357-963f-a48a981852a7

and 2035.

3.2 Indonesia Renewable Energy and Offshore Wind Power Development Policy

Indonesia has vibrant offshore wind energy resources because of owing 95,181-kilometer coastline and potential suitable for developing wind power across Indonesia, with an estimated capacity of over 9,500 MW. However, the development speed is plodding, indicating that the government's emphasis on this emerging technology needs to be strengthened. As of the statistics at the end of March 2019, the domestic land-based wind power installation capacity in Indonesia is only 1 MW to 1.2 MW.[2]

According to a World Bank research report, Indonesia's fixed offshore wind power technology has a potential exploitable capacity of up to 4.7 TW[3]. Current relevant policies mainly include:

- Presidential Decree No. 5 of 2006, Establishing the outline of the economy's energy policy.[4] In its energy development policy, although there is a wholesale purchase system, it only targets three types of projects: photovoltaic, biomass energy, and geothermal, and there is no category for wind power generation.[5]

---

2 The Wind Power, Wind energy Market Intelligence, Indonesia. https://www.thewindpower.net/country_en_67_indonesia.php

3 Janis Langer, Jaco Quist, Kornelis Blok, Review of Renewable Energy Potentials in Indonesia and Their Contribution to a 100% Renewable Electricity System. *Energies* 2021, *14*(21), 7033; **https://doi.org/10.3390/en14217033**

4 Indonesia-Asia Wind Energy Association. https://www.asiawind.org/research-data/market-overview/indonesia/

5 International Energy Agency, Global Renewable Energy, IEA/IRENA Joint Policy and Measure Database, Indonesia. https://www.iea.org/policiesandmeasures/renewableenergy/?country=Indonesia

- The 2017 Renewable Energy Procurement Policy requires Indonesia's state-owned power company PLN (Perusahaan Listrik Negara, Indonesian Power) to purchase renewable energy power.
- Administrative Order No. 12 of 2017, the Indonesian Ministry of Energy and Mineral Resources announced there are "solar and wind energy projects obtained through a bidding mechanism, and other methods of reference or direct application of tariffs." Renewable energy technologies can also receive incentives." According to this order, the types of renewable energy that can be subject to this procurement order include solar energy, wind energy, biomass energy, geothermal energy and hydropower.[6]

While the existing policies have successfully promoted the development of onshore wind power and solar power generation, they have failed to adequately address offshore wind power. It is clear that Indonesia is currently trending towards the development of wind power generation. However, due to the immature state of development quantity and technology, the policies have yet to distinctly categorize plans for onshore, coastal, or offshore wind power.

For policy gaps and future prospects, experts have highlighted several critical policy gaps that Indonesia must address to significantly improve its offshore wind power sector. These include the lack of specific offshore wind power regulations, indicating a pressing need to formulate clear goals and access mechanisms for the industry; the absence of a price support mechanism, which necessitates the establishment of a reasonable grid-connected electricity price to ensure the economic viability of offshore wind projects; and the deficiency in manpower and

[6] Indonesia, Ministry of energy and Mineral Resources, Regulation No. 12 (2017). https://www.iea.org/policiesandmeasures/pams/indonesia/name-162229-en.php?s=dHlwZT1yZSZzdGF0dXM9T2s,&return=PG5hdiBpZD0iYnJlYWRjcnVtYiI-PGEgaHJlZj0iLyI-SG9tZTwvYT4gJnJhcXVvOyA8YSBocmVmPSIvcG9saWNpZXNhbmRtZWFzdXJlcy8iPlBvbGljaWVzIGFuZCBNZWFzdXJlczwvYT4gJnJhcXVvOyA8YSBocmVmPSIvcG9saWNpZXNhbmRtZWFzdXJlcy9yZW5ld2FibGVlbmVyZ3kvIj5SZW5ld2FibGUgRW5lcmd5PC9hPjwvbmF2Pg,,

infrastructure, underscoring the importance of developing a complete industrial chain supported by skilled manpower and robust infrastructure.

If these gaps are timely addressed and combined with Indonesia's natural advantages of mild ocean currents and abundant wind energy, the economy holds substantial potential for the future development of offshore wind power. Some institutions even predict that by 2040, Indonesia could become the second-largest market for offshore wind power globally.

Overall, despite the current shortcomings in Indonesia's offshore wind power policy, the economy has the potential to become a significant hotspot for this renewable energy sector. Timely improvements in relevant laws and regulations by the government could pave the way for substantial advancements, leveraging the economy's unique geographic location adjacent to the Pacific Warm Pool.

3.3 The Philippines Renewable Energy and Offshore Wind Power Development Policy

In recent years, as the problem of climate change has become increasingly serious, the government of the Philippines has realized the importance and urgency of developing renewable energy. To this end, the Philippines has formulated and established ambitious targets for renewable energy, aiming for 35% of power generation from renewable sources by 2030 and increasing to 50% by 2040. The World Bank "Going Global-Expanding Offshore Wind to Emerging Market" report recognized the Philippines is at the forefront of wind power development in the ASEAN region, boasting a potential wind power generation capacity of 70,000 MW. The Philippines' waters hold the potential for developing 178 GW of offshore wind power, with the northern and central offshore regions possessing the most favorable wind resources. The Ministry of Energy in the Philippines has set ambitious targets for renewable energy development, aiming to achieve an installation capacity of 20,000 MW by 2040, with a specific focus on installing 1,039 MW for wind power. As of the end of 2018, the total wind power installation capacity in the Philippines had reached 475 MW, and projections suggest an increase to over 500 MW by 2020 and 2,345 MW by 2022. Despite these advancements, the actual power generation capacity in 2018 was only 427 MW.

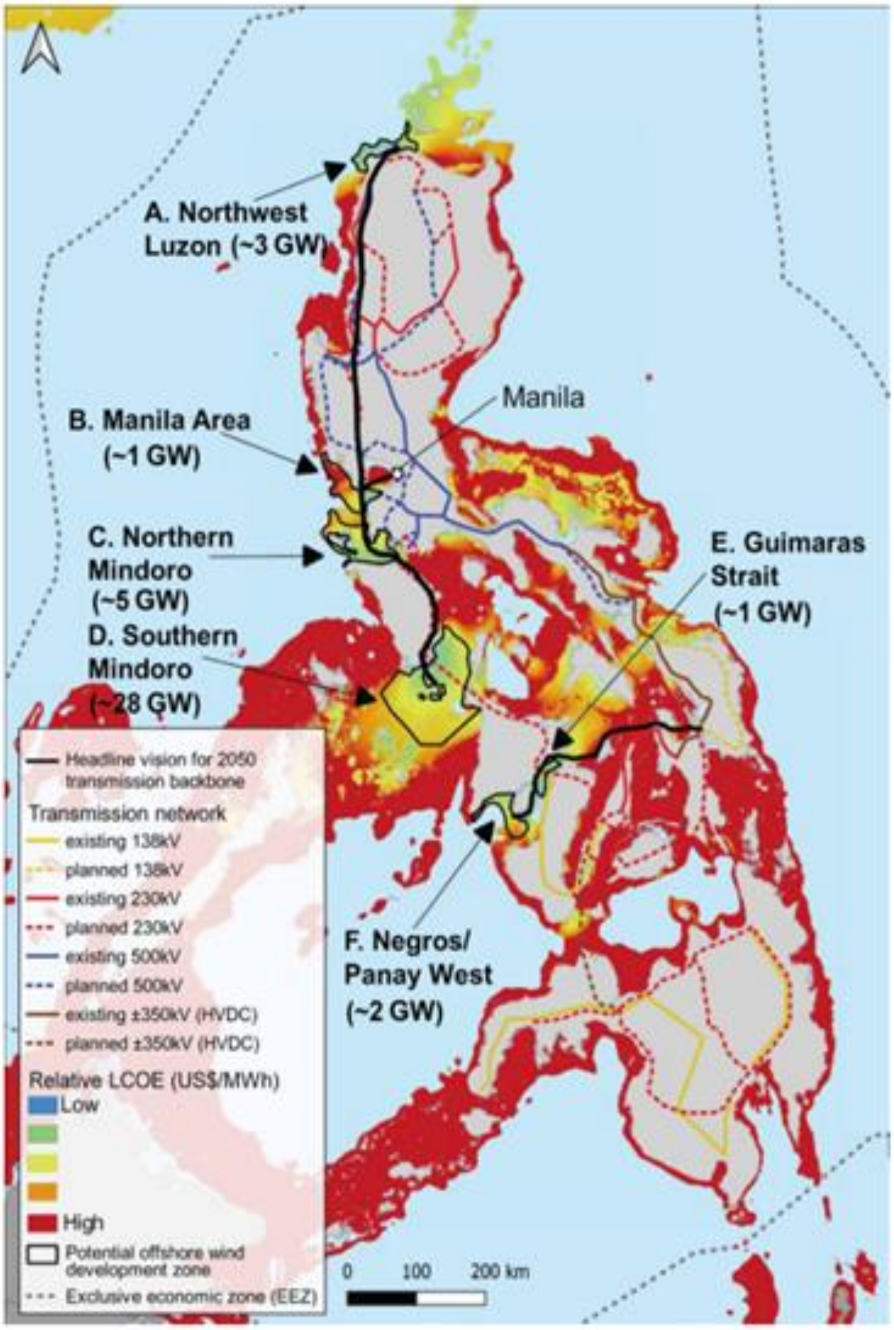


Figure 2 Offshore Wind Roadmap for the Philippines
(Source: World Bank)

The Renewable Energy Act of 2008 establishes the legal and institutional framework for the advancement of the renewable energy sector in the Philippines. The economy has prioritized development projects in hydropower, geothermal, and biomass energy, and has implemented a variety of incentives to hasten the sector's growth. The Act ensures incentives such as the feed-in tariff (FIT) scheme, which guarantees fixed price purchasing for renewable energy facilities.

The economy's 2008 Renewable Energy Plan 2020-2040 clarifies the policy framework and strategic measures for the development of renewable energy in the Philippines. It sets the goal of reaching 35% and 50% of renewable energy by 2030 and 2040 respectively. In addition to the above-mentioned regulations, the Philippines has also introduced supplementary measures such as the Biodiesel Law and the Green Energy Choice Program to support its renewable energy development.

The Department of Justice issued Opinion No. 21 on September 29, 2022, which clearly stated that the exploration, development, and utilization of solar, wind, hydro, ocean, or tidal energy are not subject to the 40% foreign equity limitation prescribed in the Philippines' Constitution for the development of natural resources. The President Marcos signed Executive Order No. 21 on April 19, 2023. The Executive Order directs the establishment of multiple offshore wind power stations in various locations across the Philippines, aimed at boosting the economy's attractiveness for investments in renewable energy. Currently, the MOE is engaged in extensive research and is formulating strategies to streamline the process of project permits and improve infrastructure, including port facilities to support offshore wind power. According to regulations, the MOE is required to finalize policies for the efficient development of offshore wind power resources within 60 days of the issuance of the administrative order.

The government of the Philippines offers two stages and 25 years of exclusive offshore wind power service and developing contracts to offshore wind farm developers. The initial phase extends for five years, during which the developer is expected to conduct various wind farm surveys, perform environmental impact assessments, secure the necessary permits, and make final investment decisions. Subsequently, the developer must submit a declaration of commerciality (DOC) to the Department of Energy (DOE). Upon approval of the DOC by the DOE, the project progresses to the second phase, wherein the developer undertakes the construction and operation of the wind farm until the 25-year contract term concludes. When the contract due, the developer holds the option to apply for an extension. As of now, the Philippine Department of Energy has issued 65 offshore wind power service contracts, collectively amounting to an installed capacity of nearly 51GW.

Although the government has yet to formulate specific policy plans for offshore wind power, some foreign developers have spotted future opportunities and begun preparations. In 2020, Windkraft Group, a joint venture between the Philippines and Switzerland, and its subsidiary Triconti ECC Renewables Corporation signed five contracts with the Department of Energy for the development rights of offshore wind farms. These projects will have a total installation capacity of at least 2 GW. The five planned wind farms include the 600MW Aparri Bay project, the 600 MW Guimaras Strait Projects 1 and 2, the 450MW Frontera Bay project, and the 600MW San Miguel Bay project. Preliminary investigations have already commenced at some of these locations.

3.4 Viet Nam Renewable Energy and Offshore Wind Power Development Policy

Viet Nam boasts over 3,000 kilometers of coastline, particularly in the southeastern region adjacent to the coast. The average wind speed of 10 to 11 kilometers per hour makes it an ideal location for the development of wind power generation. A World Bank "Going Global-Expanding offshore wind to emerging markets"[7] report indicates that Viet Nam has the potential to develop offshore wind power with a capacity of 475GW.

As early as the 2010s, Viet Nam completed the development of its first offshore wind farm with the assistance of the United States Agency for International Development (USAID). This initial near-shore wind farm is situated in Bac Lieu Province, just 0.5 kilometers from the coast, with an installation capacity of 99.2 MW. The project was completed in two phases in 2013 and 2015, respectively, and a third phase began in 2018, aiming to add an additional 142 MW of capacity. Although the government had set a target of 800 MW for wind power installations (including both land and near-shore) by 2020, only about 600 MW was achieved.

In 2018, the Vietnamese government increased the feed-in tariff (FIT) for guaranteed wind power acquisition over a twenty-year period, significantly accelerating the construction of wind power in the economy. The Electricity Corporation of Viet Nam (EVN) reported that 106 new wind farms, with a cumulative installation capacity of about 5.7 GW, applied for parallel connection and operation registration. Many of these are near-shore wind farms situated in the intertidal zone. As of October 31, 2021, EVN reports indicated that all 69 wind farms, with a combined capacity of approximately 3.3 GW, have obtained operating

7 World Bank, ESMAP, "Going Global-Expanding offshore wind to emerging markets.26 (2019). https://openknowledge.worldbank.org/server/api/core/bitstreams/04db13ea-547f-5d69-a4ad-0963d9dff06d/content

licenses. The wholesale purchase rate for near-shore wind power is USD 9.8 cents per kWh, and have boosted Viet Nam's total wind power capacity from 0.6 GW in 2020 to nearly 4 GW in a short period.

The World Bank released a report titled "Viet Nam’s Offshore Wind Development Roadmap"[8] in 2021, proposing 20 action plans to advance offshore wind power development in Viet Nam. The report analyzed both high-growth and low-growth scenarios. In the high-growth scenario, offshore wind power capacity could reach 25 GW by 2035, providing 12% of the economy's electricity needs. If maintained, this growth rate could see capacities expanding to 70GW by 2050. The Global Wind Energy Council (GWEC) also suggested that Viet Nam should increase its offshore wind power target to 10 GW by 2030.

Based on those suggestions, the Ministry of Industry and Commerce (MOIT) of the Vietnamese government has formulated the eighth edition of the ten-year Economy’s Power Development Plan. The plan estimates that the development goal for offshore wind power installation capacity will reach 2 GW by 2030 and expand to between 21 GW and 36 GW by 2045. The development plan also identifies potential sites for offshore wind farms, with a total installation capacity of 59 GW. Particularly, the central and southeastern offshore areas are highlighted, with 23 sites and a combined installation capacity of 44 GW. Additionally, the plan includes 12 sites in the southwest, with a total installation capacity of 15 GW.

Although Viet Nam currently lacks fully defined policies and regulations for developing offshore wind farms, the economy’s offshore wind power market has already attracted numerous foreign investors. These include Korea's Doosan Heavy Industry & Construction and Australia’s Macquarie Group, as well as Denmark's

[8] World Bank, Offshore Wind Development Program, Offshore Wind Roadmap for Vietnam. 2 (2021). https://documents1.worldbank.org/curated/en/261981623120856300/pdf/Offshore-Wind-Development-Program-Offshore-Wind-Roadmap-for-Vietnam.pdf

Copenhagen Infrastructure Fund (CIP) and Ørsted. Many wind farms have not only initiated site surveys but have also begun negotiating contracts with suppliers of underwater foundations, wind turbines, and engineering contractors.

3.5 Malaysia renewable energy and offshore wind power policy

Malaysia is blessed with substantial Renewable Energy resources, with almost 290 GW of technical potential estimated across the economy. Based on the Malaysia Renewable Energy Roadmap (MyRER)[9], the government adopted hydropower, solar energy, and bioenergy, to increase the target for installed RE capacity from 40% (18 GW) in 2035 to 70% (28 GW) by 2050, with the goal of renewable energy production capacity accounting for 31% (13GW) and 40% of total power generation by 2025 and 2035 respectively. Renewable energy's electricity generation capacity goal is 450 gigawatts in 2030, which accounts for 3.9% of total power generation.

Limited by wind resource conditions, wind power is not a key development direction. The amount of wind power technology that can be developed in Malaysia is only 1.4GW. As of the end of 2019, the installed wind power capacity was 0. However, Malaysia has a long coastline, and there may be certain development potential for offshore wind power.

3.6 Renewable Energy Policies in Thailand

Thailand's government adopted The Energy Plan 2036 in 2015 and decided to increase the renewable energy usage rate to 30% of total economy's energy consumption. The wind power development target is reaching 2,500 MW by 2030 and 2,989 MW installation capacities by 2036. In March 2020, Thailand unveiled its Power Development Plan (PDP) outlining an ambitious goal to augment wind power generation by 90 MW annually from 2023 through 2025. This target is set with the flexibility for upward adjustments if the outcomes are favorable. In terms

[9] Malaysia, Ministry of Economic, Economy's Energy Transition Roadmap, Energising the Economy, Powering Our Future. 32 (2023).

of offshore wind power, Thailand estimates a development potential of approximately 642 to 924 MW in the short term, 2,658 to 3,824 MW in the medium term, and 1,248 to 4,120 MW in the long term.

3.7 Japan Renewable Energy and Offshore Wind Power Policies

Japan aims to increase the share of renewable energy in its overall energy mix to 36-38% by 2030, more than double the level recorded in 2019. The wind power generation target is estimated to be 1.7% of the overall energy mix in 2030. The primary sources of this renewable energy will include solar power, wind energy, hydropower, geothermal energy, and biomass, all contributing to energy diversification and environmental sustainability. Moreover, Japan is vigorously advancing its offshore wind power initiatives, with projections indicating that the offshore wind power could optimistically reach a capacity of 10 GW by 2030, and reaching 45 GW by 2040. The 10 GW offshore wind power generation developing target also divided into 6 GW fixed offshore wind turbines and 4 GW floating offshore wind turbines. The cost of renewable energy power generation in Japan is still high compared with international standards, so the “Energy Supply Flexibility Act” of June 2020 introduced the FIP（Feed-in Premium, FIP）[10] system, which will take effect in April 2022.

The "Energy Utilization Promotion Act," the "Energy Utilization and Other Special Measures Act," the "Special Measures Concerning the Use of New Energy Power Generation by Electric Power Enterprises," “Act on Special Measures Concerning

[10] The so-called FIP (Feed-in Premium) system is a mechanism where renewable energy operators receive an additional premium subsidy on top of the market price when they sell electricity in the market. This means the payment to renewable energy operators (payment fee or electricity sales income) includes both the market price and the premium.

the Promotion of New energy Usage,"[11] and the "Renewable Energy Quota System Act" collectively clarify Japan's new energy development goals and related responsibilities. The "New Energy Utilization Promotion Act" specifically sets a target for the proportion of new energy to be a certain percentage of the original electricity demand. This law promotes the utilization of renewable energy through legal measures to achieve more environmentally friendly and sustainable energy development.

Japan is located within the Pacific Rim Seismic Zone, an area distinguished by its complex and dynamic maritime conditions. Natural phenomena, such as wind vortices and wave activity, significantly heighten the risk of damage to wind power infrastructure. Additionally, natural disasters like typhoons and tsunamis pose considerable threats to the structural integrity and operational safety of these facilities. Local governments typically issue sea area occupation licenses for a duration of 3-5 years. However, this is insufficient compared to the 20-year usage period mandated by the Feed-in Tariff (FIT) scheme, thus presenting a significant constraint for offshore wind power developers. Furthermore, the coordination of sea area utilization among the offshore wind industry, shipping industry, and fisheries remains unclear.

To address the aforementioned challenges, Japan enacted the "Law on the Utilization of Marine Areas Related to the Development of Marine Renewable Energy Power Generation Facilities"[12] in April 2018. This law permits the

[11] 新エネルギー利用等の促進に関する特別措置法. Act No. 37 of April 18, 1997. https://policy.asiapacificenergy.org/sites/default/files/Act%20No.%2037%20of%201997%20%282005%20Ed.%29.pdf

[12] 海洋再生可能エネルギー発電設備の整備に係る海域の利用の促進に関する法律 (Law on the Utilization of Marine Areas Related to the Development of Marine Renewable Energy Power Generation Facilities)。No. 89, 2018(平成 30 年)。Japan's "Sea Area Utilization Promotion Law Regarding the Construction of Marine Renewable Energy Power Generation Equipment" was voted by the Economy's Assembly in November 2018. According to the Act, in order to promote the development and utilization of sea areas, marine renewable energy power

designation of specific sea areas as promotion zones for offshore wind power projects, contingent upon the non-interference with the fishery and shipping industries. Selected constructors in these designated areas are granted sea area use rights for a period of 30 years. As end of 2022, Japan's total installed capacity for offshore wind power generation stands at a mere 136 megawatts (MW). In comparison to Japan's ambitious targets of achieving 10 gigawatts (GW) by 2030 and 45 GW by 2040, this figure indicates that the economy has barely made any initial progress.

Technological innovation in Japan's offshore wind power is primarily focused on floating offshore wind power generation. By utilizing floating structures, these innovations overcome the deep-sea installation limitations inherent in fixed wind power systems, facilitating the development of deep-sea wind farms located further offshore. This approach significantly enhances the efficiency of wind resource utilization. The Japanese government uses green innovation funds and other methods to support and promote research on floating wind power related technologies.

In March 2024, Japan inaugurated the Floating Offshore Wind Power Technology Research Association (FLOWRA), a novel industrial consortium aimed at fostering technological innovation in offshore and floating wind power facilities. This platform is dedicated to reducing costs and facilitating the mass production of floating offshore wind energy through collaborative efforts with the academic community. Additionally, in April 2024, Japan and the United States finalized an agreement to collaborate under the 'U.S. Floating Offshore Wind Shot' initiative, supported by the Clean Energy and Energy Security Initiative (CEESI), to drive

---

generation equipment can occupy sea areas for a long time. Therefore, it is necessary to formulate basic policies, designate promotion areas, determine the coordination framework with early users such as the shipping industry and fishery, and determine the occupation of sea areas. and other related project certification systems. Available at: https://elaws.e-gov.go.jp/document?lawid=430AC0000000089 groundbreaking advancements in offshore wind power technologies, significantly reduce technological costs, accelerate the decarbonization process, and provide substantial benefits to coastal communities.

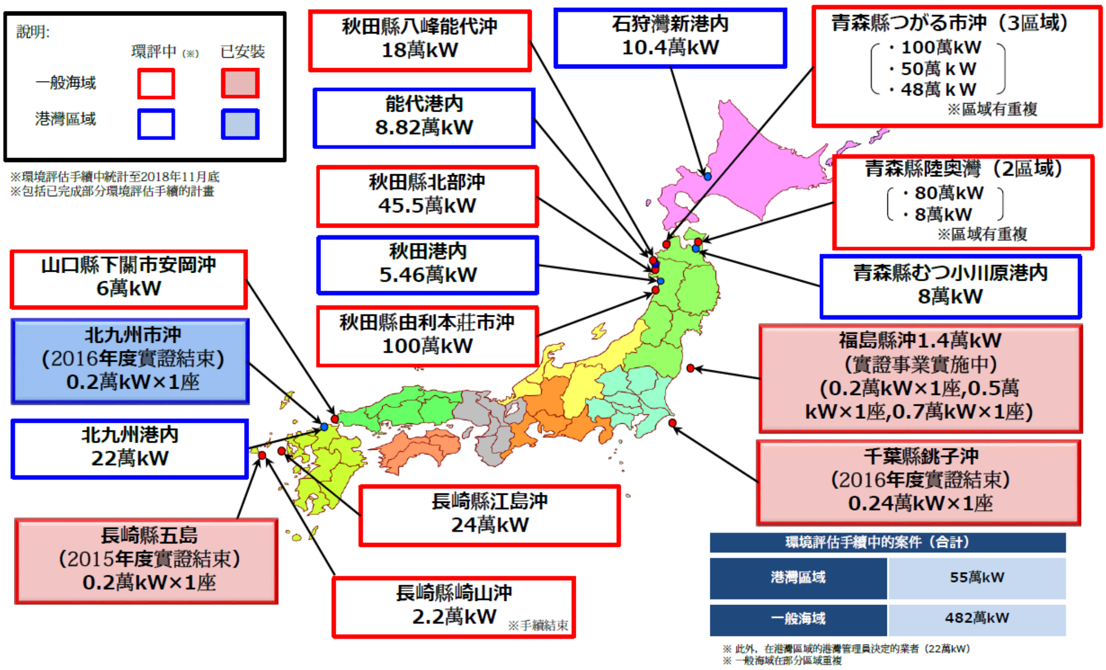


Figure 3 Japan offshore wind power sites

Source: 日本でも、海の上の風力発電を拡大するために[13]，経済産業省 資源エネルギー庁，2018/12/6

[13] Agency for Natural Resources and Energy. 日本でも、海の上の風力発電を拡大するために，December 06, 2018.Available at https://www.enecho.meti.go.jp/about/special/shared/img/pynk-2b8tg3d3.png

3.8 Korea Renewable Energy and Offshore Wind Power Policies

In 2017, Korea unveiled its "Renewable Energy 2030 Implementation Plan (RE2030)," setting an ambitious target for renewable energy to constitute 20% of total power generation by 2030, with solar photovoltaics and wind power accounting for over 95% of this share. The plan projects a significant increase in solar photovoltaic capacity from 5.7 GW in 2017 to 36.5 GW by 2030. Concurrently, wind power generation is expected to expand from 1.2 GW to 17.7 GW, with the potential to reach 18-20 GW under optimal conditions, particularly emphasizing growth in offshore wind power capacity. To achieve the Renewable Energy 3020 Vision, the plan aims to augment installed wind power capacity from 2,405 MW in 2021 to 23,000 MW by 2034. The Korean Ministry of Energy reported that as of late 2021, the economy's installed wind power capacity had attained 1,143 MW, with onshore wind power comprising over 95% of this total. Moving forward, Korea intends to progressively expand its wind power installed capacity to address the pressing challenges of climate change and meet the demands of carbon reduction policies.

In August 2021, Korea enacted the "Basic Act on Carbon Neutrality and Green Growth" (commonly referred to as the Carbon Neutral Law) to achieve carbon neutrality by 2050. The implementation of this Act commenced in 2022. Under this legislation, Korea is mandated to reduce its emissions by 40% of the 2018 level by 2030. In January 2023, Korea's Presidential Committee on Carbon Neutrality and Green Growth adopted the "10th Long-term Electricity Supply and Demand Basic Plan," proposing a renewable energy share target of 21.6% of total electricity mix by 2030. By 2036, the proportion of new and renewable energy power generation is expected to reach 30.6%. This new target represents a 6% increase from the target set for 2020. [14]

[14] IEA, World Energy Outlook, 2021. https://iea.blob.core.windows.net/assets/4ed140c1-c3f3-4fd9-acae-789a4e14a23c/WorldEnergyOutlook2021.pdf

According to the "Offshore Wind Power Development Plan" unveiled in July 2020, Korea has set an ambitious goal to elevate its offshore wind power capacity from the current 12 GW to between 18-20 GW by 2030. This target increasing is intended to enhance offshore wind power generation and is projected to create approximately 770,000 job opportunities within the new and renewable energy sectors. Despite achieving the total renewable energy installation capacity targets for two consecutive years, the progress in offshore wind power development has not met expectations. To meet the 2030 target, the plan focuses on large-scale offshore wind projects distributed across several regions: Jeollabuk-do (2.4 GW), Sinan (8.2 GW), Ulsan (6.0 GW), Jeju Island (0.6 GW), and Incheon (0.6 GW). These projects have faced significant opposition due to concerns over resident displacement and impacts on fishery incomes, leading to results that have fallen short of the anticipated targets. The Korean Ministry of Trade, Industry and Energy has assessed that the siting, licensing, and construction of offshore wind power facilities typically require more than seven years. Therefore, there is a pressing need to accelerate the development process within the next three years to successfully achieve the 2030 capacity goals.

In 2012, to reduce costs and encourage competition, Korea transitioned from the original "Feed-in Tariffs (FiT)" system to the "Renewable Portfolio Standard (RPS)." The RPS mandates that enterprises with power generation capacities exceeding 500 MW must utilize at least 5% of renewable energy for power generation, based on 2018 levels, with this requirement increasing annually by 1%. By 2023, the proportion of renewable energy in power generation is expected to reach 10%. Non-compliance with these regulations will result in a penalty amounting to 150% of the average Renewable Energy Certificate (REC) price for that year.

The Korean government has not yet passed the draft bill of the "Special Law on the

Promotion of Wind Power" or the draft "Marine Utilization Impact Assessment System." Consequently, the requirements for conducting a marine environmental impact assessment prior to the implementation of offshore wind power projects have not yet been put into effect.

3.9 Renewable Energy And Offshore Wind Power Policies in the US

The U.S. federal government implements a number of regulations and laws to promote the usage and development of renewable energy. These regulations cover a variety of aspects, including the procurement of renewable energy, tax credits and research funding. Federal government support policies have played a crucial role in the development of the U.S. renewable energy industry. In the past decade, the amount of renewable energy power generation in the United States has increased significantly, and the proportion of renewable energy in the U.S. energy mix has also continued to increase. The related laws include: (1) Energy Policy Act of 2005 (EPAct): This act requires federal agencies to purchase a certain percentage of renewable energy and provides tax credits for renewable energy projects. (2) Energy Independence and Security Act of 2007: This Act further expands support for renewable energy, including loan guarantees and grants for renewable energy projects. (3) American Recovery and Reinvestment Act of 2009: This bill allocates billions of dollars for renewable energy projects, including solar, wind and geothermal energy projects. (4) 2015 Clean Power Plan: This plan was launched by the Obama administration to reduce carbon emissions and promote the use of renewable energy. Pursuant to Section 203 of the Energy Policy Act of 2005[15], the federal government is mandated to consume a minimum of 7.5% of its total electricity from renewable sources each fiscal year. This mandate is commonly referred to as the renewable electricity requirement.

The Biden-Harris Administration has approved over 25 GW of clean energy projects by enhancing renewable energy production on public lands and waters.

[15] 42 U.S.C. § 15852. Federal purchase requirement:(a) Requirement. The President, acting through the Secretary, shall seek to ensure that, to the extent economically feasible and technically practicable, of the total amount of electric energy the Federal Government consumes during any fiscal year, the following amounts shall be renewable energy: (1) Not less than 3 percent in fiscal years 2007 through 2009. (2) Not less than 5 percent in fiscal years 2010 through 2012. (3) Not less than 7.5 percent in fiscal year 2013 and each fiscal year thereafter.

This includes a commitment to deploy 30 GW of offshore wind by 2030, 15 GW of floating offshore wind by 2035, and a target of permitting at least 25 GW of onshore renewable energy by 2025.[16] The government has implemented a series of initiatives to promote the development of renewable energy. These initiatives encompass setting a target to reduce net greenhouse gas emissions by 28% by 2030, relative to 2005 levels, and establishing an objective to install at least 30 GW of offshore wind power on public lands by 2030, recognizing the critical role of offshore wind power in achieving carbon neutrality. Furthermore, the administration seeks to expedite the permitting and construction of onshore wind, solar energy, and other renewable energy projects on public lands, to deploy 25 GW of renewable energy by 2025. Substantial investments are also being directed towards clean hydrogen and emerging clean energy technologies, including a $7 billion investment in clean hydrogen clusters. Additionally, new solar power incentive programs have been introduced, such as the expansion of the residential solar tax credit, aimed at reducing household electricity costs and promoting distributed photovoltaic power generation.

The U.S. federal government has set an offshore wind power generation target of 30 GW in 2030, of which the capacity of floating offshore wind power equipment will reach 15GW in 2035. The U.S. Department of Energy's Advanced Materials and Manufacturing Technologies Office (AMMTO) supports "innovative manufacturing technologies for wind turbine equipment" and "innovative domestic production of large metal components for offshore and onshore wind" research projects to reduce costs and shorten completion times on fixed-base offshore wind power. The goal is to reduce the cost of fixed-base offshore wind to 51 cents per GWh by 2030.

[16] Department of the Interior, Clean Energy Future, Developing a robust and sustainable clean energy economy. Available at https://www.doi.gov/priorities/clean-energy-future

The Biden administration plans to commence bidding for leasing federal waters along the Atlantic coast (from Maine to the Carolinas), the Pacific coast (from California to Oregon), and the Gulf of Mexico by 2025. This initiative is designed to facilitate the development of U.S. offshore wind power and to achieve the administration's target of 30 GW of offshore wind power generation by 2030.

The Federal, State, and local governments in the United States will conduct ecological and environmental assessments of proposed wind power plant sites. If a potential site is found to harm organisms, conflict with military activities, damage underwater archaeological sites, or negatively impact tourism, it may be deemed unsuitable for leasing. According to U.S. media, commercial fishing groups, coastal landowners, and environmental organizations may attempt to obstruct the development project. It is also noted that the Gulf of Mexico, predominantly an area for oil and natural gas extraction, may see fossil fuel companies opposing offshore wind power development to protect local mining operations and safeguard their business models.

3.10 Chile Renewable Energy and Offshore Wind Power Development Policies

Chile's objectives include achieving a peak in greenhouse gas emissions by 2025, systematically phasing out coal-fired power plants by 2040, and positioning itself as the inaugural South American economy to declare net-zero emissions by 2050.

The government passed the "Unconventional Renewable Energy Law" (Law 20.257), in 2008 and established a target for non-conventional renewable energy to constitute 20% of total power generation by 2025. It also introduced tax incentives, subsidies, and other supportive policies for renewable energy companies. Additionally, the “Green Tax Law” (Law 20.780), adopted in 2014, imposed a carbon tax on power plants emitting significant amounts of carbon dioxide to promote a transition towards renewable energy generation.

In 2015, Chile promulgated the Economy’s Energy Policy 2050, which aims to achieve 20% renewable energy power generation by 2025 and 60% electricity from renewable sources by 2035. The policy further targets an increase in the proportion of renewable energy to 70%, accompanied by the formulation of relevant action plans. Therefore, the Chilean government announced the "2035 and 2050 Energy Goals" strategy in 2022, which aims to achieve 60% renewable energy power generation by 2035 and attain carbon neutrality by 2050. Notably, Chile met its 2025 target of 20% renewable energy power generation ahead of schedule in 2018. By 2025, 20% of the economy's power generation is projected to come from renewable sources. Looking ahead, Chile aspires to achieve 75% renewable energy power generation by 2030.

Chile’s renewable energy development goal is for the proportion of renewable electricity to reach 60% by 2035 and 70% by 2050. Chile has established goals to further integrate renewable energy into its energy structure. Practical measures include achieving approximately 35% renewable energy power generation by 2021 and increasing this proportion to 42% by the end of 2023. The long-term objective is to elevate the share of renewable energy power generation to 70% of the total energy mix by 2030, with 20% of power generation coming from renewable sources.

Chile's wind energy installation capacity increased by over 18% in 2019 compared to 2018, with new installations reaching 526 MW. In 2020, this capacity further increased by more than 30% compared to 2019, with new installations totaling 683.5 MW. Currently, the operational wind energy installation capacity in Chile stands at 2.83 GW. Chile has set a target of achieving at least 1 GW of floating offshore wind power by 2030. To this end, an offshore wind power development roadmap has been formulated, aiming for an installed offshore wind power capacity of 2.8 GW by 2030. Additionally, the installed capacity of wind power is projected to increase by 12% in 2026 compared to 2021.

3.11 Canada Renewable Energy and Offshore Wind Power Development Policies

In 2022, renewable energy accounted for 16.9% of Canada's total primary energy supply. Hydropower remains the most significant renewable energy source, representing 59.6% of power generation in 2018. This is followed by wind energy and biomass energy, which contributed 5.8% and 1.9% to power generation, respectively. Onshore wind power accounts for 7.7% of Canada's total electricity generation, with the installation capacity expected to reach 15 GW in 2023.

The Canadian government's "2030 Emissions Reduction Plan" outlines a comprehensive strategy to combat climate change. To fulfill its commitment to carbon neutrality, one of the plan's core objectives is to completely phase out coal-fired power generation by 2030 and ensure that renewable energy is prominently integrated into the economy's electricity supply. The proportion of enterprises utilizing renewable energy is targeted to increase from the current 66% to over 90%, with a long-term goal of achieving 100%. The plan also includes measures such as actively promoting carbon emission standards, implementing carbon pricing systems, and providing subsidies for renewable energy development. Achieving net-zero electricity generation by 2035 will mean that Canada's electricity system no longer produces any greenhouse gas emissions. To reach this goal, Canada must transition to renewable energy sources on a large scale, including wind, solar, and hydropower.

Canada possesses significant potential for offshore wind development, attributable to the high-quality resources available along its coasts and offshore areas. However, as of 2024, no offshore wind projects have been constructed in the economy. Canada is anticipated to complete its first offshore wind farm in the Province of Nova Scotia. Nova Scotia has committed to offering leases for 5 GW of offshore wind energy by 2030, commencing in 2025, with the ultimate aim of supporting green hydrogen production.

Chapter 4.
Growth of marine renewable energy and combined marine renewable energy (CMRE)

Hybrid offshore renewable energy projects integrate different renewable energy sources, such as wind and solar, to take advantage of their respective strengths and reduce dependence on any one source. Offshore wind turbines can be paired with floating solar panels, which can be installed on the sea surface and are supported by floating structures that include a ballast and anchoring system. This will help to utilize the same infrastructure for both sources of energy, reducing costs and increasing efficiency.

According to the International Renewable Energy Agency (IRENA), the global installed capacity for marine energy (excluding offshore wind) reached approximately 30 megawatts (MW) by the end of 2019, with the majority of this capacity derived from tidal energy. In contrast, offshore wind power has experienced substantial growth in recent years, with global installed capacity surpassing 30 GW by the end of 2019.

As of the end of 2019, Europe was the frontrunner in marine renewable energy, hosting the majority of the world's installed capacity. The European Commission reports that Europe accounted for more than 80% of the global installed capacity for tidal energy and over 60% of the global installed capacity for wave energy. Furthermore, Europe boasted the largest installed capacity of offshore wind power globally, with over 20 GW installed across several economies. Leading European economies in terms of installed offshore wind power capacity include the United Kingdom, Germany, and Denmark.

4.1 EU Legal Framework for CMRE

The European Union has established a comprehensive policy framework to promote and regulate Coastal and Marine Renewable Energy (CMRE) through several key directives. The Renewable Energy Directive (2009/28/EC) outlines the EU's overarching goals and targets for renewable energy, including CMRE. It mandates EU member states to set economy's targets for renewable energy shares, implement support schemes, and adopt measures to eliminate barriers to renewable energy uptake. A specific example within this directive is the promotion of offshore marine energy projects. Complementing this, the Marine Strategy Framework Directive (2008/56/EC) provides a framework for the protection of the marine environment, ensuring that human activities, including CMRE projects, do not adversely impact marine ecosystems. This directive necessitates that CMRE developments are compatible with marine environmental protection goals, highlighting limitations for offshore energy development.

Further, the Spatial Planning Directive (2014/89/EU) requires EU member states to engage in marine spatial planning (MSP) by 2021. MSP aims to systematically plan human activities in marine environments, identifying and mapping areas suitable for CMRE projects while minimizing conflicts with other marine uses. Lastly, the Environmental Impact Assessment Directive (2011/92/EU) establishes a framework for evaluating the environmental impacts of specific public and private projects, including CMRE initiatives. It obliges EU member states to assess potential environmental impacts and implement measures to mitigate any negative effects, ensuring that CMRE projects are developed sustainably and responsibly.

4.2 United Kingdom

The United Kingdom has set ambitious targets for the deployment of marine energy technologies, including offshore wind, wave, and tidal energy. To facilitate the development and deployment of these technologies, the economy has established a supportive policy and regulatory framework. The Crown Estate, which manages the seabed around the UK on behalf of the government, has designated specific areas for marine energy projects and auctioned off leases for these areas to developers. Additionally, the government provides financial support for marine energy projects through the Contracts for Difference scheme, which guarantees a fixed price for electricity generated by eligible technologies, including offshore wind and certain types of wave and tidal energy.

Furthermore, the UK government has committed to deploying 40 GW of offshore wind capacity by 2030 as part of its broader goal to achieve net-zero greenhouse gas emissions by 2050. This commitment includes support for research and development in marine energy, funded by organizations such as the Carbon Trust and the Marine Energy Alliance. These efforts underscore the UK's dedication to advancing marine energy technologies and contributing to global sustainability goals.

4.3 Belgium

The Belgian Government has set a target to generate 13% of the economy's electricity from renewable energy sources by 2020 and 32% by 2030. To achieve these targets, the government provides support for renewable energy projects through various incentive schemes, including feed-in tariffs and quota systems.
On January 20, 1999, Belgium enacted legislation titled "Protection of the Marine Environment in the Sea Areas under the Jurisdiction of Belgium." The primary objective of this law is to safeguard the natural environment, biodiversity, and marine ecosystems within Belgium's maritime jurisdiction. The legislation comprises specific chapters addressing marine protected areas and species protection, the prevention and mitigation of environmental pollution,

environmental impact assessment (EIA) procedures, authorization requirements, emergency measures for marine protection, and penalties for violations.

On July 20, 2012, the Belgian government amended the existing law. The first amendment involved renaming the legislation to the "Law for the Protection of the Marine Environment and the Organization of Marine Spatial Planning in the Sea Areas under the Jurisdiction of Belgium." The second amendment introduced the Belgian marine spatial plan, which now orchestrates the desired spatial and temporal dimensions of human activities. These operations are required to be future-oriented, with economic, social, and environmental objectives forming the foundation of maritime activities. The primary aims of the marine spatial plan are to coordinate decisions affecting the sea area and to ensure that all stakeholders are considered in the planning process.

A new Article, 5a, was integrated into the amended Law of January 20, 1999. This article details the structure, procedures, and duration of the marine spatial plan. The governmental procedure for the marine spatial plan comprises a planning process, a public investigation, a strategic ecological impact report, and potential amendments. The government is required to review the marine spatial plan every six years. According to this new article, the structure of the marine spatial plan must include a spatial assessment of the Belgian sea area, a long-term perspective on its usage, and specific economic, social, environmental, and safety objectives. Additionally, the structure must delineate the measures and instruments that support the implementation of the marine spatial plan.
The consideration of introducing and developing a marine spatial plan in Belgium predates the EU Commission's actions in 2014. In March 2014, a Royal Decree introduced the first Belgian marine spatial plan, covering the period from 2014 to 2020 (Belgian Marine Spatial Plan, 2014). This initial plan designated a specific zone in the Belgian part of the North Sea (BPNS) for the development and establishment of renewable energy projects. The allocated zone is situated in the

eastern part of the BPNS, directly adjacent to the Dutch part of the North Sea (Belgian Marine Spatial Plan, 2014, p. 34).

On May 22, 2019, Belgium adopted its second Belgian Marine Spatial Plan, which came into effect on March 20, 2020, and will remain valid until 2026 (Marine Spatial Plan 2020, 2020, Art. 33). Article 8 of the Marine Spatial Plan 2020 established three additional legal zones for electricity production from renewable energy sources. These zones, located in the western part of the Belgian part of the North Sea (BPNS) and extending northeast, are designated as Noordhinder North, Noordhinder South, and Fairybank. The zone defined in the previous spatial plan is referred to as the Eastern zone.

The distinction between maritime zones represents a significant difference in planning and managing the sea environment compared to continental spaces. While governments exercise full sovereignty rights over their economy’s territories, the marine ecosystem and structure are inherently more complex and dynamic than those on land. Sudden environmental changes can have unpredictable and far-reaching impacts on the marine ecosystem, including those arising from the construction of renewable energy technologies.

Most economies consider marine space a public good, precluding private ownership. However, specific areas may be designated for temporary use while the space remains generally a public good. Marine space can be divided into four dimensions: the seabed and sub-seabed areas, the subsurface and water surface, the airspace above the sea, and the temporal dimension, given that some activities are seasonal or time-dependent. This four-dimensional framework provides an excellent basis for the multiple uses of marine space. A notable difference between land and marine spatial planning is that many subsurface marine areas remain unexplored, necessitating ongoing research and monitoring to uncover these unknown regions. The concept of multiple space use is integral to Belgium's long-term development strategy for maritime space, contingent upon thorough environmental impact assessments. In the context of renewable energy, it is proposed that wind power plants could feasibly be combined with electricity generation from wave or tidal sources.

Belgium has established itself as a pioneer among EU economies by implementing a marine spatial plan extending to 2026, which emphasizes the concept of multiple space utilization and prioritizes offshore wind, wave, and tidal energy. The potential inclusion of offshore solar PV installations, given their technological similarities to wave energy systems, is also under consideration. However, the practical implementation of this multiple-use concept within the framework of competitive bidding procedures remains ambiguous. The evolution of the permitting process is evident: previously, operators like THV Mermaid were required to obtain comprehensive permits for combined projects prior to tendering. The current system allows offshore wind farm operators to participate in tenders, with successful bidders automatically securing both permit rights for specific areas and financial support. These permits grant operators the authority to utilize the entire allocated area with the technology specified in their bid. While this system facilitates straightforward implementation for single-technology projects, such as offshore wind farms, it presents challenges for multi-technology initiatives. Operators seeking to combine offshore wind farms with solar PV installations, for instance, must include this combination in their initial bid. The Belgian regulatory framework lacks clear guidelines for integrating new projects or implementing multiple uses within existing installations, particularly given that domain concession permits typically restrict access to allocated areas by other parties. This regulatory gap, coupled with the practice of granting temporary domain concession rights for entire areas to initial operators, presents significant challenges to the realization of Belgium's multiple-use space concept in practice.

The Belgian Government has set a target to generate 13% of the economy's electricity from renewable energy sources by 2020 and 32% by 2030. To achieve these targets, the government provides support for renewable energy projects through various incentive schemes, including feed-in tariffs and quota systems. In October 2023, the Belgian government approved an environmental permit for Princess Elizabeth Island, the world's first "artificial energy island" with 3.5 GW of capacity and will link the UK and Danish electricity markets (Power Technology, 2024). Deme and Jan De Nul, a Belgian marine services company, won the tender in February 2023, demonstrating that economies within the EU feel secure in the existing legal framework and can release tenders, approve EIAs, and ultimately deliver commercial projects hybridizing storage and transmission interlinks between three electricity markets, with plans to develop 2.3GW of wind capacity within in the zone.

In 2020, Belgium completed the construction of its first offshore wind farm area, consisting of wind turbines with a combined generating capacity of 2,262 megawatts (MW). This offshore wind farm is expected to produce an average of 8 terawatt-hours (TWh) of renewable electricity annually. The economy has ambitious plans to further expand its offshore wind energy generation, with proposals to establish a new, larger offshore wind farm zone that would increase the total capacity to 4,400 MW or even 6,000 MW by 2030, (Delbeke et al., 2023). While a small economy and one with relatively recent offshore wind success they have taken a strong approach CMRE development.

Belgium has developed its marine spatial planning since 2012. With a consultation process covering all stakeholders concluding in 2018, and with the MSP coming into force in 2020. During the process, renewable energy, the blue economy, and nature protection were identified as key areas. Which all encourage efficient use of ocean space and hybrid renewable projects.

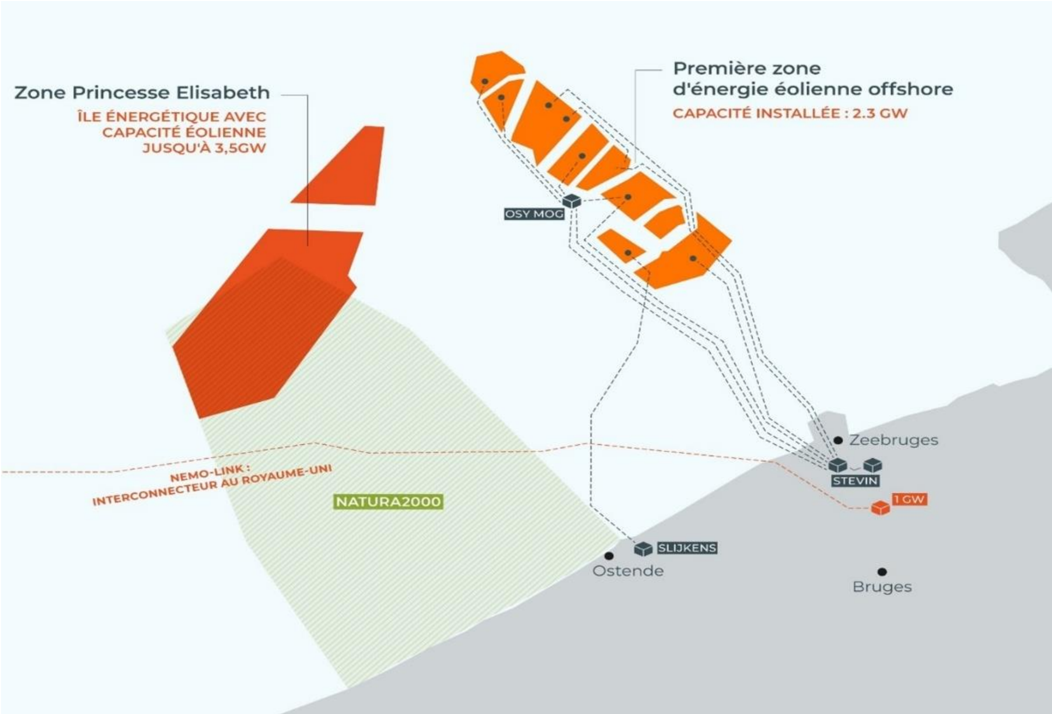


Figure 4 Image from Elia Group

(Source: https://www.elia.be/en/infrastructure-and-projects/infrastructure-projects/princess-elisabeth-island#)

The approval for the energy island required mitigating development impacts on marine habitats and coastline as nearby ecosystems are covered under the Natura 2000 framework (Federal Public Service Economy of Belgium, 2023,). According to the government "*As the MSP already determines the external borders of the Princess Elisabeth Zone, an internal zoning will have little to no impact on the users around the zone. The division of the parcels precedes the tender, for which this division is primordial*." This suggests that in future cases governments can take existing renewable energy zones, and without repeating another EIA process, zone them to allow for hybrid energy uses as storage, transmission, or additional marine energies would not have significantly different impacts than offshore wind. Some considerations for princess Elizabeth island are specific to the project and relate to the subdividing of parcels:

- Protection of pleasure shipping lanes to the United Kingdom.
- Protection of sand extraction that currently takes place in Zone 2
- Avoiding straining the course of navigation between Zone 2 and Zone 3
- Limiting the environmental impact in the most sensitive areas.
- Impact of wake effects (minimal distances between wind turbines) and the optimal coordination between the implantation of the turbines

As of this writing, the final environmental impact abatement strategy has not been released, but environmental permits for construction have been approved, it seems unlikely that they will differ significantly from existing offshore wind abatement.

Lessons to be learned from Belgium include a long-term approach and one not necessarily based on size. Belgium is not particularly large, but due to its strategic location between the UK and other North Sea economies it found an opportunity to balance power transmissions, further enhanced by a battery and offshore wind network. While they have the same policy pressures as the Netherlands and the EU, they have taken a unique path that may be profitable in the future. The project itself considers natural habitats and tries to abate these issues. One can see here how years of work built upon multiple frameworks made this project desirable for development.

4.4 China

China's State Power Investment Corp (SPIC) has implemented the world's first commercial offshore floating solar power plant, utilizing patented technology designed by the Norway-based company Ocean Sun. This groundbreaking facility, situated off the coast of Haiyang in Shandong province, Eastern China, represents the first integration of floating solar power with offshore wind energy. The installation comprises two floaters, each with a peak capacity of 0.5 MW, connected to a transformer on an SPIC-owned wind turbine. This transformer is subsequently linked to a submarine cable, facilitating power transmission. Upon completion of the pilot period and comprehensive technical and economic evaluation, Ocean Sun reports plans to develop an additional floating wind-solar project with a total capacity of 20 MW in the following year, further advancing this innovative approach to renewable energy generation.

4.5 Denmark

Denmark has demonstrated a significant commitment to marine renewable energy, particularly in the realm of offshore wind power. The Danish Wave Power Roadmap, published in 2015 in collaboration with nine Danish wave developers, underscores the economy's focus on tidal energies. According to Denmark's Energy Agreement of 2018, the economy aims to derive at least 50% of its total electricity consumption from renewable sources by 2030, with wind energy constituting the majority. Furthermore, Denmark has set an ambitious target to increase wind energy's share in its total energy mix to a minimum of 50% by 2030. To achieve this, the economy has established a goal of installing at least 11 GW of wind power capacity by 2030, with a minimum of 2 GW sourced from offshore wind power.

Denmark's leadership in offshore wind power development is rooted in a long-standing tradition dating back to the 1970s. The economy currently operates several large-scale offshore wind farms, with numerous additional projects in various stages of planning and construction. The Danish energy strategy extends beyond wind power, incorporating wave and tidal energy into its renewable energy portfolio, with the aim of increasing the overall share of marine renewable energy in its total energy mix. The Danish Wave Power Roadmap outlines plans for developing pilot wave energy projects in the coming years, focusing on enhancing knowledge and reducing costs associated with wave energy. These initiatives align with Denmark's overarching goal of becoming a leader in sustainable energy, with marine renewable energy playing a pivotal role in realizing this ambition.

4.6 Italy

Italy has established ambitious targets for renewable energy, including marine renewable energy, aiming to increase the share of renewable energy in its total energy mix to at least 30% by 2030. Specific targets have been set for the deployment of offshore wind power. The Italian government aims to install at least 3 GW of offshore wind power capacity by 2030 and is actively developing offshore wind projects in the Adriatic Sea. Additionally, Italy recognizes significant potential for wave and tidal energy in the Mediterranean Sea and has identified several areas suitable for the development of marine renewable energy projects, while also assessing the environmental impacts of such initiatives.

Several Italian companies are advancing projects that integrate offshore wind power, including floating turbines, with floating solar power plants in the Adriatic Sea, thereby fostering hybrid offshore renewable energy projects. Italy's Energy and Climate Plan for 2021-2030, officially approved and published in October

2020, reaffirms the economy's commitment to increasing the share of renewable energy and reducing greenhouse gas emissions. Marine renewable energy is anticipated to play a crucial role in achieving these objectives.

4.7 Netherlands

Differing from Belgium in its incentives and projects, the Netherlands also leads in hybrid offshore energy system development. The Dutch Government have also approved tenders and began early construction of offshore hybrid projects. In the case of the Netherlands, floating offshore solar is the focus instead of energy transmission or storage.

The Netherlands famously has limited land area, yet the government has also made ambitious commitments to net-zero targets and renewable energy production. Due to land constraints and agricultural pressure the Dutch energy strategy requires solar PV to go on roofs and not compete with other land uses, this combined with a large shallow coast and neighbors with grid interconnections there have been numerous pilot and even commercial scale floating solar projects (Golroodbari et al., 2021). Also, this policy has prompted the Dutch government to explicitly state that deployment of photovoltaic (PV) solar systems should predominantly be done at roofs (Rijksoverheid, 2019), while the huge potential of offshore PV has been recognized in a roadmap for PV systems and applications (Folkers et al., 2017). This combination of policies virtually requires development of offshore solar and combined projects.
In reviewing environmental impact assessment documents from hybrid solar-wind projects, some interesting aspects emerge that contrast with other EU and North Sea economies approach to CMRE. The Dutch MSP and the Water Plan 2016-2021 and the Norh Sea Policy Document are all developed based on principles of multiple usages of space, these regulations lay the framework for offshore energy development. The economy's Water plan itself promotes the use of combined renewable energy resources saying that the cabinet should prioritize "generation of renewable energy: sufficient room for wind energy and other forms of renewable energy, *combined wherever possible*" (Water Plan, 2024). This emphasis has been included in the updated North Sea Policy Program which expands to include other

types of combined marine energy uses such as the development of offshore hydrogen production (North Sea Programme, 2024).

For developing specific combined energy sites, A permit, under the Water Act, is required where activities involve a fixed structure on the seabed or in the water column at the same location for an extended period of time. The permit application is followed by an assessment, which considers the impact on the maritime environment, the wind farm, and the other users of the North Sea. A recent project application that was approved for one of the first combined floating solar and wind sites demonstrates that there are no legal barriers and in fact regulatory support for this approach in the Netherlands.

Summarizing the Netherlands approach to hybrid offshore energy, one can see a government moving towards hybrid energy systems without hesitation and instead with multiple layers of support. Current Dutch policy aims to co-locate offshore activities like floating solar photovoltaic (OFPV) systems with offshore wind farms (OWFs) due to limited marine space availability. Economy's policies limiting onshore solar and economy's solar targets necessarily create demand for collocating energy projects at sea. Marine policy documents like the Water Plan and the North Sea policy document provide legal and policy recommendations for these combinations. Now developers have in turn proposed combined projects with some positioning their success as a Dutch sign of energy success (Euronews, 2024). This demonstrates that while technological challenges exist to combined marine renewable energies the underlying incentives and support seem to correlate with actually viable projects.

When analyzing economy policies, it is clear that a commercially viable offshore wind sector, an enforced MSP, and renewable energy targets all drive combined marine energy systems. Belgium and the Netherlands demonstrate how these factors are shaped by local conditions. The United Kingdom however, despite having all of these features and an onshore solar sector does not have the same types of combined energy systems in development and can serve as a useful lens for comparison.

4.8 Sweden

Pursuant to the marine spatial plan adopted in Sweden in 2014, provisions for marine renewable energy have been incorporated, facilitating the identification of potential areas for the development of such projects. The aforementioned plan aims to achieve a balance in the utilization of marine resources across various sectors while ensuring the environmentally sustainable development of marine renewable energy projects.

With respect to renewable energy targets, Sweden has established the objective of increasing the share of renewable energy in its total energy mix to 50% by 2020 and 100% by 2040. This objective encompasses marine renewable energy, and the economy has set forth specific targets for the deployment of offshore wind power. Furthermore, Sweden has set a target for wind power generation to reach 30 TWh by 2030 and is actively engaged in the development of offshore wind power projects in the Baltic Sea and the North Sea. The achievement of this target is anticipated through a combination of onshore and offshore wind power, with the marine spatial plan serving as a crucial instrument in identifying suitable sites for offshore wind power development. Additionally, Sweden is currently in the research and development stages for wave and tidal energy, which is regarded as an emerging industry within the economy.

4.9 France

Defined targets and objectives have been established to integrate marine renewable energy (MRE) into the economy's energy mix. The 2015 law on energy transition was amended in 2019 to encompass both bottom-mounted and floating offshore wind technologies, although there is no explicit mandate for marine renewable energy (MRE).

4.10 Portugal

Portugal has demonstrated a commitment to marine renewable energy (MRE) through various strategic government documents since 2007, aiming to optimize marine space, foster synergies, and minimize conflicts among marine activities. This is exemplified by the 2017 MRE Roadmap and the integration of MRE development into the marine spatial plan (MSP), which designates specific areas for MRE projects, including the Agucadoura test site and the Pilot Zone spanning from San Pedro de Moel to Viana do Castelo.

4.11 United Kingdom

The United Kingdom has set ambitious targets for the deployment of marine energy, including offshore wind, wave, and tidal energy with a target of 2,000 GW of installed capacity of offshore wind by 2050 (Putuhena et al., 2023). The UK has been a global pioneer in offshore wind development, achieving an installed capacity of 13.9 GW (Department for Business, Energy & Industrial Strategy. (2023). Several licensing laws establish the framework for offshore wind energy or licensing for offshore renewables including The Planning Act (2008); the Marine and Coastal Access Act (2009); the Electricity Act (1989); the Energy Act (2004). While the legislation supports offshore wind it remains less flexible around CMRE.

The Crown Estate, which manages the seabed around the UK on behalf of the government, has designated areas for the deployment of marine energy projects and has auctioned off leases for these areas to developers. The government also provides financial support for marine energy projects through the Contracts for

Difference scheme, which guarantees a fixed price for electricity generated by eligible technologies, including offshore wind and some types of wave and tidal energy(Caine, 2020). Yet currently, no CMRE projects are in pilot or development stages in the UK and tidal projects continue to face challenges to scale.

While current legislation is in draft, Ofgem the UK energy regulator has launched a series of consultations on licensing frameworks for CMRE and hybrid energy assets with the majority of work focusing on hybrid assets connecting transmission and offshore wind (Ofgem, 2023). In terms of licensing, it is a new type of activity: dual activity of offshore transmission and interconnection which is not covered by the existing legal framework. Through this process several benefits were identified including increasing efficiency of construction and usage of infrastructure, allowing the same cable to be used for wind energy transmission and cross border trade. Make use of RE that might be curtailed in economy, and in turn reducing the overall system costs and providing a route to market for wind developers, increased grid flexibility.

Economy	**Offshore RE Target**	**MSP**	**Pilot Projects**	**Operational Projects**
Germany	No	Yes		
Belgium	Yes, additional points in bidding	MSP, encourages multi-usage and storage	None yet, tender in process	No, only preliminary studies
Netherlands	Yes, additional points in bidding	MSP, and Water Policy	Yes	Yes (link)
Denmark	Yes	Yes		
United Kingdom	Yes	Yes	No, only tidal	None
Portugal	Yes	Yes	Pilot projects coming now	None

China	Yes	??	Yes (https://balkangreenenergynews.com/china-completes-worlds-first-hybrid-offshore-wind-solar-power-plant/)	
Finland	Yes to wind, but not marine	Yes	No	No
Sweden	Yes to marine	Yes	No	No
Italy	Yes	Yes		
France	No	Yes		

The Crown Estate, which manages the seabed around the UK on behalf of the government, has designated areas for the deployment of marine energy projects and has auctioned off leases for these areas to developers. The government also provides financial support for marine energy projects through the Contracts for Difference scheme, which guarantees a fixed price for electricity generated by eligible technologies, including offshore wind and some types of wave and tidal energy(Caine, 2020). Yet currently, no CMRE projects are in pilot or development stages in the UK and tidal projects continue to face challenges to scale.

While current legislation is in draft, Ofgem the UK energy regulator has launched a series of consultations on licensing frameworks for CMRE and hybrid energy assets with the majority of work focusing on hybrid assets connecting transmission and offshore wind (Ofgem, 2023). In terms of licensing, it is a new type of activity: dual activity of offshore transmission and interconnection which is not covered by the existing legal framework. Through this process several benefits were identified including increasing efficiency of construction and usage of infrastructure, allowing the same cable to be used for wind energy transmission and cross border trade. Make use of RE that might be curtailed in economy, and in turn reducing the overall system costs and providing a route to market for wind developers, increased grid flexibility.

The UK's consultation identified challenges with licensing offshore hybrid asset projects based solely on their intended use. Previously, offshore energy projects would be licensed for a single purpose, which impacted insurance, costs, taxes, and other factors associated with offshore wind development. However, if an offshore site aims to serve multiple objectives like generation, transmission, energy storage, or even additional uses like fisheries, the licensing process becomes more complicated. This is not the key barrier for CMRE in the UK, rather it is something newer economies can anticipate and draft legislation for in advance.

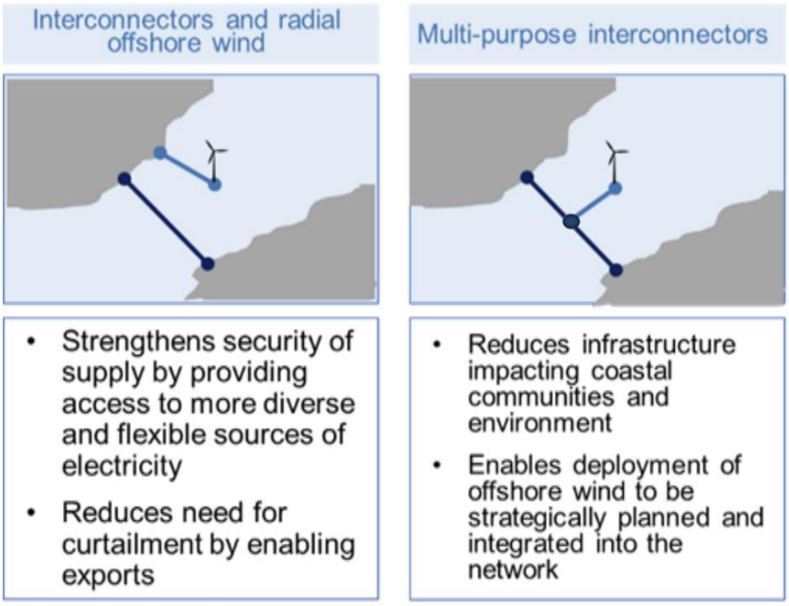


Figure 5 Interconnector and radially connected offshore wind farm (left) compared to an MPI (right) (Source: Ofgen, 2003)

To address this, the UK recognized the need to amend the electricity act to allow more flexibility. The existing legislation did not account for scenarios where a generation site might not transmit enough power, or a transmission site ends up storing energy instead of just transmitting it. Additionally, projects could potentially be built in sequential phases, starting as generation facilities before transitioning into transmission and storage roles over time. The current legislation did not accommodate this type of changing project scope. In essence, the UK found that the rigid licensing approach based on a single intended use was inadequate for the evolving landscape of offshore hybrid assets that combine multiple functionalities. Amending the laws would enable a more flexible licensing framework better suited to these multifaceted projects.

While the UK has the same elements as Belgium and the Netherlands and even shares the same body of water, the outcome in supporting combined offshore energy differs due to economy's political goals and targets. While draft legislation is in process for hybrid projects, CMRE projects are not as advanced as other economies. This helps to show that offshore wind, MSP, and renewables are needed but not sufficient for advancing CMRE. This differs with the US which although it had an advanced RE sector and widespread MSP throughout various states offshore wind is slow to develop and CMRE is not on the horizon.

4.12 Germany

Germany has established ambitious renewable energy targets, with a particular emphasis on offshore wind development. The economy aims to generate 65% of its total electricity from renewable sources by 2030, with wind energy, both onshore and offshore, projected to contribute 40-45% of this share. To facilitate the achievement of these objectives, the German government has implemented a comprehensive support framework, including financial incentives for renewable energy projects and substantial funding for research and development across various renewable energy technologies. Concurrently, Germany is actively pursuing advancements in solar energy, setting a target to increase its share in the economy's energy mix by at least 50% by 2030. While no offshore solar projects are currently operational, ongoing research is exploring the potential of floating solar panels, demonstrating Germany's commitment to diversifying its renewable energy portfolio and maintaining its position at the forefront of sustainable energy innovation.

4.13 Finland

Finland implemented a comprehensive marine spatial plan in 2012, which underwent revision in 2017. This plan encompasses the entirety of Finland's marine waters, including the Baltic Sea and the Gulf of Bothnia, and is designed to ensure the sustainable and efficient utilization of these aquatic resources. The plan incorporates provisions for marine renewable energy development as part of its broader scope.

The primary objective of the marine spatial plan is to maintain and enhance the marine environment, preserving its biodiversity and ecosystem services while simultaneously facilitating the sustainable exploitation of natural resources, including marine renewable energy. This approach aims to strike a balance between economic, social, and environmental considerations. In terms of specific renewable energy targets, Finland aspires to increase the share of renewable energy in its total energy mix to 38% by 2030. Although the plan acknowledges the potential for wave and tidal energy in the Baltic Sea, Finland has not established explicit targets for marine renewable energy deployment. However, the plan outlines the economy's commitment to increasing the use of renewable energy in maritime transport and sets an ambitious goal of reducing CO_2 emissions by 80% by 2050. Additionally, Finland has established a target to augment wind power generation to 10 TWh by 2030, which may encompass offshore wind power installations.

4.14 United States

The approach towards offshore renewables in the United States has differed dramatically to Europe. Unlike the Europe or the UK there are not many successful offshore wind projects (Hansen et al., 2024).While marine spatial planning in the US has been in process since 2009, with several coastal states having completed the process and many others in a different stage of completion (McAteer et al., 2022).There is only early stage legislation around hybrid offshore renewable energy. In reviewing US legislation, it becomes clear that offshore wind energy forms the basis of hybrid offshore energy and partially explains the advancement in the EU.

The United States is currently lacking any combined offshore wind and solar energy projects, despite being at the forefront of developing both technologies independently. This absence can be attributed to several key factors that have hindered the integration of these two renewable sources in the offshore environment. The regulatory and permitting frameworks for offshore energy projects in the U.S. have been primarily designed to accommodate single-source projects, such as offshore wind or offshore solar. Introducing a hybrid system that combines multiple technologies would likely necessitate navigating complex and potentially untested regulatory pathways, adding uncertainty and delays to project development processes. Unlike the UK the US is not currently addressing this as it has challenges with offshore wind alone.

Furthermore, current market incentives and policy support in the U.S. have largely focused on advancing offshore wind and offshore solar independently. The absence of incentive structures specifically tailored to encourage the development of hybrid offshore wind-solar projects has further contributed to the lack of such initiatives.

For this research, the US demonstrates that MSP policies, economy’s offshore energy targets, and high levels of deployable capital do not lead to CMRE or even offshore wind projects. For a variety of reasons, the US just has not developed this same capacity that in the case of Belgium and the Netherlands they have had to due to limited land are and a reliance on interconnections. That said, the US as of this writing has one offshore wind project online with many others in the pipeline and it is a priority of the Biden Administration to reach their offshore energy goal.

4.15 Synthesis and Observations

The European Union's legal framework for combined offshore renewable energy projects offers a valuable model for APEC economies seeking to develop similar initiatives. As global renewable energy standards continue to drive development, they inevitably face challenges related to land-based zoning. In Europe, marine renewables have gained popularity due to decreasing costs and fewer restrictive stakeholders. The implementation of marine spatial planning (MSP) across the EU since 2014 has further encouraged the growth of marine renewable energy (MRE). MSP requires stakeholder engagement and public data sharing, leading to the designation of marine zones for renewables. This designation creates immediate advantages through compatible uses, such as the grouping of transmission lines for offshore wind, tidal, or solar projects, making combined projects appealing to both developers and regulators.

Hybrid MRE projects offer significant benefits over standard MRE projects in three key areas: increased energy generation, grid or utility network effects, and scalable maintenance. Energy generation is enhanced by combining solar, wind, tidal, and storage technologies, while grid or utility network effects can be observed in examples like the North Sea, where Belgium integrates energy storage. Scalable maintenance is achieved by leveraging the different seasonal mix periods of wind and solar, which can reduce the high costs of regular marine maintenance. Multi-use platforms can further reduce maintenance costs by servicing multiple uses, such as transmission, solar, wind, or tidal energy.

Despite several notable EU projects promoting offshore marine energy, there has not been a concerted push for mixed, combined, or shared renewable energy beyond generic support from EU directives. However, successful projects that combine wind and solar demonstrate the potential for combined renewable energy initiatives to offer substantial benefits and efficiencies. These projects tend to succeed because they generate more energy, reduce costs, create transmission opportunities, and appeal to a broad range of stakeholders by integrating different marine energy sources. When developing legal frameworks for combined offshore renewable energy in APEC economies, it is crucial to consider these legal aspects and best practices from the EU experience.

While further research is needed, especially of other economies within the EU and beyond that have successfully trialed CMRE, there is straightforward evidence in these four cases that a matrix of existing marine and renewable legislation is sufficient to provide a legal framework for continued development. Regulations actually seem to trail technology in this context and given decades of agreement in the EU around renewables, MSP, and marine development it seems only natural to make those energy systems as dense as possible. At the same time, local factors are impossible to ignore.

Belgium targets offshore energy storage and transmission before adding wind, while the Netherlands prioritizes floating solar due to their land constraints. In the UK where grid connects pose a challenge, but offshore wind is world class the focus remains on transmission. And the US with many other energy challenges and priorities is a late comer to offshore renewable development. Given those local constraints, some common development trajectories emerge.

Economy	Offshore RE Target	MSP	Pilot Projects	Operational Projects
Belgium	Yes, additional points in bidding	MSP, encourages multi-usage and storage	Yes	Yes – energy storage
Netherlands	Yes, additional points in bidding	MSP, and Water Policy	Yes	Yes – floating solar and wind
United Kingdom	Yes	Yes	No, only tidal	None
United States	Yes	For many coastal States	No	None

When looking at reviewed economies an obvious division exists between economies with a developed offshore wind market and those without, further, those with specific marine energy targets perform better. While more research across the region and beyond is needed, a step-wise approach for policy development tracing Europe's progress can be developed.

First, economies need an offshore renewable energy target along with incentives and regulations to develop the offshore wind industry. At present, the most efficient combination is combining currently commercially viable offshore wind projects with increasingly viably offshore floating solar projects.

Second, at the same time, or shortly before an economy also needs to successfully complete a MSP process. Without an agreed upon and aligned vision of where renewable energy can develop, where grid interconnects or transmission lines may go, and a shared vision of shipping it will be cost prohibitive and complex to develop combined offshore energy and missed the opportunity to streamline EIAs.

Third, the economy requires some type of offshore energy target. While Belgium and the Netherlands differ in their emphasis, the end result is increasing regulatory support for CMRE projects whether storage and interconnect driven or solar driven, that gives developers the financial confidence to invest in these risky and potentially costly projects.

Lastly, none of this development in Europe would be possible without multi-year research projects piloting and modeling CMRE projects. While such a large-scale initiative may not be needed for APEC as Belgium and Netherlands already have pilot projects, there is a vast amount of additional research and development needed. With growing interest in multi-use platforms there is a variety of CMRE that could exist as costs decline for tidal, wave, hydrogen production, seaweed production, or any other type of combined sustainable ocean usage.

Looking at the United Kingdom we see almost all of the same elements as Belgium and the Netherlands, yet CMRE still lags behind. This research did not deeply explore Scotland or Wales which do have tidal and wave energy projects near wind and aquaculture sites. This could be explored further in research. At the UK level, instead the government prioritizes transmission projects connected to offshore wind given their number of existing interconnects and difficulties with their existing grid and adding additional capacity.

With the United States, one can see the vital necessity of an offshore wind industry as the base of development. Initially, one might assume that MSP and offshore energy, fossil fuel and oil production, would provide enough of a legal framework. Yet, in practice this appears not to be the case. The skills and competencies, along with the incentives differ enormously between oil and wind. Incentives are minimal for combining renewable energy with oil production, and as such the US without an offshore wind industry lag behind Europe in CMRE.

Offshore renewable development in Europe should not be viewed as a gold standard, but rather as an early adopter that has over multiple decades trialed and modeled different energy types with at times questionable success. Gaps in current EU hybrid energy exist and one of the largest is planning, with multiple competing frameworks driving these developments there is not one overall organizational body to oversee these developments. When analyzing the EU's progress, a haphazard approach comes across with economies trialing different locally derived energy combinations without an interconnected or grand plan.

Those weaknesses identified, APEC economies can benefit from studying the progress Europe has made to avoid similar pitfalls and speed up development of CMRE.

4.16 European Union (EU) Collective Legislation and Policies

The EU has multiple intersecting policies that come together to provide both regulatory frameworks and incentives for hybrid marine energy. Three main policies provide both the legal framework and incentive structure for a wide range of offshore hybrid energy systems: the renewable Energy Directive, the Marine Strategy Framework, and the Spatial Planning Directive.

The pursuit of offshore energy has gained significant momentum driven by the ambitious goal of achieving net-zero greenhouse gas emissions by 2050. According to the European Commission's long-term strategy, electricity demand is projected to surge by 150% by the mid-century mark, with wind power anticipated to meet half of this demand and offshore wind accounting for a staggering 25% of the target. This projection suggests a substantial buildout of installed wind capacity, reaching an almost inconceivable 400GW, compared to the current installed capacity of 25GW (Orsted, 2024). This burgeoning demand not only catalyzes the development of offshore wind but also directly encourages the exploration of additional energy sources, such as marine energy. Policymakers, recognizing the need for extensive offshore wind installations, are actively seeking cost-saving opportunities to maximize energy generation from limited resources.

The renewable Energy Directive (2009/28/EC) sets out the EU's overall objectives and targets for the promotion of renewable energy and establishes a framework for supporting the development of renewable energy that includes hybrid marine renewables. It requires EU member states to set economy's targets for renewable energy establish support schemes for renewable energy, and adopt measures to remove barriers to the uptake of renewable energy (deCastro et al., 2019). While at the time not expressly intended these economy's target requirements drive developers towards CMRE due to competition for other types of renewables.

While EIAs are relevant to these processes, they do not shape sector level decisions at the EU level, instead member states carryout specific EIAs, they are clearly a consideration in citing hybrid projects but the EU legal framework for them is not relevant in the case of offshore hybrid renewables. Ultimately, the Renewable Energy Directive III also set out a framework for renewable go to areas (G2As) that would speed up environmental permitting by only requiring one EIA per parcel and that initial EIA would cover all subsequent projects within the G2A. This was enacted in order to speed up and streamline permitting given the EU's renewable energy targets and goals. The proposed maximum time to approve new installations is set to 12 months, and 24 months outside these zones (European Commission Joint Research Centre, 2024). While not explicitly focusing on marine energy development, these go to areas inevitably drive planners and developers to continue hybridizing offshore marine energy as other areas face more restrictions. In these same proposals acceleration shall not be allowed in Natura 2000 sites, bird routes, or biologically sensitive sites, sites must prioritize built and artificial surfaces, mines, water treatment sites, etc. Given the existing development limitations, it is not surprising that developers have proposed combining floating marine solar and offshore wind to hit renewable targets, take advantage of increased permitting, and avoiding biologically significant sites (European Commission, 2023). The EU's robust marine protection further encourages density of ocean development.

To safeguard marine and coastal developments the Marine Strategy Framework Directive (2008/56/EC) establishes a framework for the protection of the marine environment, including the implementation of environmental policy for the marine waters of the EU. It requires EU member states to adopt measures to protect the marine environment and ensure that human activities do not negatively impact it. This includes the development of CMRE projects, which must be undertaken in a way that is compatible with the protection of the marine environment. Few studies have looked at the marine biodiversity or ecological impacts of CMRE, yet preliminary studies looking at marine solar show light impacts relative to other developments or energy sources (Hooper et al., 2021; Vlaswinkel et al., 2023)

Since current research suggests floating solar doesn't cause significantly more negative impacts than existing wind. Existing renewable energy zones may in fact be the only areas to add additional solar energy for some economies given existing marine development restrictions. While the marine strategy framework supports conservation, another framework manages ocean spaces.

The Spatial Planning Directive (2014/89/EU) establishes a framework for the systematic planning of human activities in the marine environment and requires EU member states to conduct marine spatial planning (MSP) by 2021. MSP can be used to identify and map out areas for the development of CMRE projects in a way that minimizes conflicts with other uses of the marine environment. Mapping out marine spaces for certain activities has the effect of highlighting areas for marine energy development and increases the incentives to develop multiple forms of energy in the same marine space. Offshore wind for example requires transmission lines and regular maintenance, if floating solar was placed near these offshore wind turbines they can reduce conflict with other marine uses than if sited separately.

Together, the renewable energy directive, marine strategy framework, and the spatial planning directive come together to not only clarify policies and regulations around the development of hybrid marine renewables, but they also encourage their development by doubling up on benefits. Renewable energy directives increase projects on land, driving interest in ocean projects, and increasing overall economy targets that cannot be cost effectively achieved without utilizing ocean and coastal areas. The MSP framework set up agreed zones for offshore wind that later enabled transmission lines, these areas now seem appropriate for multiple energies given their existing consensus around development. And lastly, the strong marine protection sets another legal limit on types of offshore energy development encouraging consolidation.

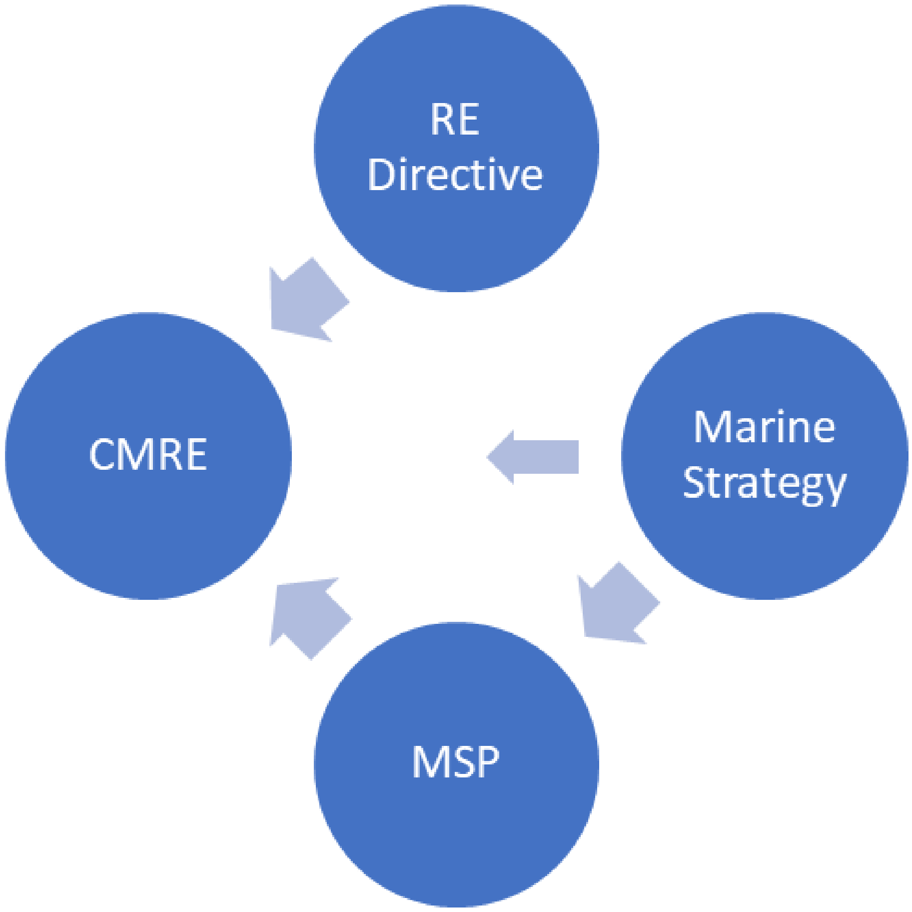


Figure 6 Legal influences of EU level legislation on CMRE.

Besides the existing regulatory environment driving incentives for hybrid offshore energy development. Various EU and institutional research organizations provided long-term research funding for a variety of mixed ocean energy projects.

4.17 Long-term Institutional Support for CMRE

A handful of EU research projects have charted out and developed the potential of hybrid offshore energy assets. The EU Scores project with funding of EUR44 million has on-going publications and research coming out as the project finishes in 2024. EU-SCORES will demonstrated multiple hybrid offshore energy projects including: a 3 MW floating offshore solar PV installation in Belgium combined with bottom fixed wind as well as a 1.2 MW wave installation combined with floating wind in Portugal(Van Der Zant et al., 2024). The project includes the construction and planning of the needed infrastructure for such a combined energy park as well as the business case supporting its bankability.

Across the EU there are eleven different funding schemes available for various types of offshore renewable energy This was further supported by the EU strategy of on offshore renewable energy setting out a target of 11 GW of offshore renewables by 2030 (European Commission, 2024). While support and regulation occur at the EU level, it is up to individual member states to develop their own projects in partnership with developers. Each economy takes a slightly different approach or emphasis based on their existing economy level goals, incentives, and industries. Two leading EU economies for CMRE are review, along with the UK, and the US.

Chapter 5.

Offshore Wind and Marine Spatial Planning as Driver of Hybrid Energy

According to the International Renewable Energy Agency (IRENA), global installed capacity for offshore wind in 2022 was 63 GW (EPO and IRENA, 2023). Total marine energy installed capacity had reached 524 megawatts (MW) by the end of 2022, with the majority of that capacity coming from tidal energy. Of marine energies, only offshore wind is commercially mature. Tidal projects are increasing, but offshore marine solar remains at a largely pilot stage.

Understanding the scope of marine offshore energy, it is obvious that offshore wind has driven the development of energy planning within Europe's Ocean areas. Within the United States, United Kingdom, and European Union MSP policies pre-date and inform the development of hybrid offshore renewable energy plans(O'Hagan, 2020). The growth of offshore wind energy also matched the growth of marine spatial planning processes in Europe and was seen, among many other reasons, as a way to implement offshore wind and other competing ocean uses efficiently, since offshore wind developers were the only renewable developers participating in stakeholder MSP processes they naturally played a role in the locating of renewable energy zones (Jay, 2010). In practice, despite the proximity of offshore wind sector to the MSP process, there is not always a strong relationship, the two processes have informed each other as the offshore wind and offshore energy industry in general are both key stakeholders, it should not be viewed that wind fully drove that process but was instead embedded within (Spijkerboer et al., 2020). When exploring legislation, it becomes clear there are interactions between offshore wind development, MSP processes, and renewable targets but without specific oversight.

Expanding on this foundation, given that offshore wind requires certain geographic constraints, stable wind, relatively shallow water, and transmission access back to land, there are limited areas to place these sites. Then, when limited by on-land energy development constraints and coastal biodiversity protection, hybrid projects of all varieties become increasingly valuable. The European Union is the world leader in offshore hybrid projects, their study and policy, and advocating these systems.

Combined marine renewable energy (CMRE) has evolved from pilot projects to commercial energy activities, with numerous projects in the pipeline. This growth is the result of decades of research and policy regulations surrounding offshore energy development, starting with the advent of offshore wind and inter-economy electricity connections, coupled with marine spatial planning. Global commitments to renewable energy and Europe's energy concerns have further accelerated these developments. How have two European leaders, The Netherlands and Belgium, established a policy framework around CMRE? Conversely, why have the UK, with its strong offshore capabilities, and the US, with its robust marine spatial planning, lagged in CMRE development? By analyzing the approaches of these four economies, APEC economies can leapfrog in developing legislation that promotes offshore renewables and fosters the growth of these new energy systems.

5.1 Recommendations for the APEC Economies

When determining the suitability of appropriate legislation for CMRE, looking across the APEC region there exists a variety of capacity for marine renewable energy development that suggests a diverse or modular approach is needed. A workshop hosted in Chinese Taipei titled 'APEC Workshop on Promotion of Multifunctional Ocean Space Usage for Renewable Energies Combination (EWG 13 2021A)' brought together international experts from Australia; Chile; Indonesia; Japan; the Philippines; and The United States, to share their perspectives on CMRE in their region.

Using these economies as a representative base one could find shared challenges across the regions. Of the listed economies Japan and the US sit in a similar position where they have developing offshore wind industries, marine policy management capacity, and are making progress towards offshore renewables. Another group of economies Australia; Chile; Indonesia; and the Philippines have started extensive exploration of marine renewables particularly offshore wind and are at various stages of development. There is a third category of economies that either do not have offshore energy potential or have not started progressing yet, in which case lessons from Europe are not relevant. Other differences limit the broad application of the EU's experience.

Grid interconnection is a key element of energy development in the EU and UK, such interconnects are not immediately commercially viable across most APEC economies, although there are proposals for a transmission connection between Australia and Singapore, Australia-Asia Power Link (AAPowerLink) although this isn't linked with marine energy it could follow a similar trajectory to Europe that when successfully completed this project leads to marine based transmission and ultimately CMRE in the future.

APEC Economy	Offshore Wind Energy Generation	Legal Status of Marine Spatial Plans
Australia	In progress	Economy, but not yet implemented
Brunei Darussalam	No	No specific legal framework
Canada	In progress	Economy, legally recognized
Chile	No	No specific legal framework
China	Yes, leader	Economy, legally recognized
Hong Kong, China	No	No specific legal framework
Indonesia	No	No specific legal framework
Japan	Yes	Economy, legally recognized
Korea	Yes	Economy, legally recognized
Malaysia	No	No specific legal framework
Mexico	No	No specific legal framework
New Zealand	No	Economy, legally recognized
Papua New Guinea	No	No specific legal framework
Peru	No	No specific legal framework
The Philippines	No	Economy, legally recognized
Russia	No	No specific legal framework
Singapore	No	Similar MSP concept in force
Chinese Taipei	Yes	Economy, legally recognized
Thailand	No	Regional pilots
United States	Yes	Economy, legally recognized
Viet Nam	Yes	Framework approved 2023

When reviewing all APEC economies under this framework, reviewing the status of economy's MSP policies and offshore wind production similar trends emerge. of APEC economies China; Korea; Japan; Chinese Taipei; the US; and Viet Nam all have offshore wind projects online to varying degrees of completeness with China being a world leader in offshore wind. While not fully in scope of this research it is worth noting that China does have combined offshore wind and floating solar projects online.

APEC economies with offshore wind in progress or in operation and with MSP could immediately begin trialing combining multiple types of offshore renewables and began research collaboration with Europe to grow the sector further.

Chapter 6.
Project Workshop

6.1 INTRODUCTION

On 20 and 21 February, 2024, the APEC Workshop on The Legislation Recommendation And Promotion Of Multifunctional Ocean Space Usage: Combine Floating PV Installations At Offshore Wind was initiated by Chinese Taipei and co-sponsored by Australia; Japan; Thailand; and the United States was held in Taichung, Chinese Taipei. Speakers and participants came from global organizations and research institutions and representatives from APEC member economies' relevant Ministries and government's agencies, companies and business associations that relates to energy in APEC economies and across the APEC region.

The Workshop aimed to help APEC and non-APEC economies and stakeholders to share about opportunities and challenges on combination of different renewable energy facilities towards a low carbon economy. Through this workshop, the capacity of participants will be built to interact face-to-face, exchange current legitimate research on multi-functional usage in ocean space for further developing the energy security, resilience and meets the APEC Leaders Meeting in Kuala Lumpur in 2020 to collaborate to facilitate access to affordable energy and enhancing energy security using the widest variety of technologies to support sustainable economic growth.

The workshop hosted at Taichung, Chinese Taipei on 20-21 February 2024. The participation performance of this workshop was calculated as following chart. The women participation rate was over 40% of all participants and comply the APEC requirements.

Gender	**number**	**ratio**
Male	33	58%
Female	24	42%
Total	57	

Speakers statistic conclusion show s as following chart. The women speakers number and participation rate was also over 40% of all participants.

Speaker	**number**	**ratio**
Male	5	50%
Female	5	50%
Total	10	

The participants from APEC economies show as following.

Economies	Attendee
Australia	1
Chilie	1
Indonesia	8
Malaysia	3
Peru	2
The Philippines	3
Chinese Taipei	14
Thailand	7
United States	1
Viet Nam	3
Non-APEC	14
Total	**57**

The workshop photos are shown in Appendix A.

6.2 BACKGROUND

In order to prevent adverse impacts caused by climate change, the APEC Leaders agreed to reduce fossil fuels usage. The 2014 APEC Leaders' Declaration suggested the renewable energy development goal is "double the share of renewables including in power generation by 2030 in APEC's energy mix". The using renewables in power generation could benefit the development of renewable energy technologies and the reduction of greenhouse gas emission. Since the land space is limited, some APEC economies installed offshore wind turbine machines or floating PV panels for extra spaces. However, the spaces usage among the offshore wind turbines and the height below the blades, and above the ocean surface are not well organized and remain empty. Those spaces could install more renewable energy facilities, for example, the mid-size wind turbine machines or floating PV panels setting among the towers. For those APEC economies do not own proper wind farm natural conditions, they could establish offshore floating PV panels to create renewable energy. Both ocean space usage and green electricity generation will be increased. The “multi-functional usage in ocean space” proposal is promoting sustainable energy growth by combining offshore wind turbines and floating photovoltaic (PV) panels in the open territorial sea surface and apply to the grid system. These mixed renewable sources can strengthen the domestic energy security, as well as lower the carbon intensity. It could not only benefit the growth of renewable power generation but also the growth of renewable energy technology innovation. It will stimulate economic development and application, to reduce carbon dioxide (CO_2), and eventually produce green energy and empower the local community for sustainability.

Currently, most of APEC developing economies are facing land pressures because of population growth, economic developing demands and renewable energy developing policies. In order to cope with this land-scarce situation, exploration of the ocean surface within the territorial sea cold provide extra spaces to promote renewable energy development. However, most APEC economies have not established regulations to manage ocean spaces and prevent more technologies and participants inputs from public and private sectors yet. Some of them only have separated regulations to control the activities in the ocean surface and their territorial air space but not ready to regulate the mixed space usage.

6.3 OPENING REMARKS

In the opening remarks, Dr. Chi-Wen Liao (APEC EGNRET Chair) highlighted that the open ocean is a good area to facilitate several renewable energy installations and also benefit the renewable energy generation to achieving the common goals of the APEC region: doubling the proportion of renewable energy in the total primary energy supply by 2030 (compared to the level of 2010) as directed by APEC Economic Leaders.

With that meaning, the Workshop was organized with the desire to provide an overview of regulations and laws related to ocean space utilization and evaluate the results achieved in promoting APEC's energy security. At the same time, the Workshop is expected that participants will be able to exchange current legitimate research on multi-functional usage in ocean space for further developing clean energy in the APEC region in the future.

6.4 KEY ISSUES

1. INTRODUCTION TO THE LEGISLATION RECOMMENDATION AND PROMOTION OF MULTIFUNCTIONAL OCEAN SPACE USAGE

The speaker in the Session was Dr. Keng Tung Wu, Associate Professor, Department of Forest, Chung Hsing University, Chinese Taipei. He explained the major goal of this project aiming to promote “multi-functional usage in ocean space” and integrates both offshore floating photovoltaic panels and wind turbines in the same offshore wind farm. It meets the 2019 APEC priorities to facilitate access to affordable energy and strengthen domestic and regional energy security while mitigating the environmental effects of the energy supply of the major goals of EWG.

The scarcity of land as a limited natural resource has posed a challenge to advancing renewable energy development. To address this obstacle, there is a focus on maximizing the use of ocean space for both generating electricity and optimizing available areas beneath offshore wind turbines. The concept of "multi-functional usage in ocean space" is being explored as a means to promote sustainable energy growth by integrating offshore wind turbines with floating photovoltaic (FPV) panels on the open ocean surface. This approach aims to leverage the vast potential of ocean resources to overcome land limitations and drive the expansion of renewable energy solutions.

This Workshop was being conducted to enhance the capabilities of participants, with a focus on supporting the concept of "multi-functional usage in ocean space." Additionally, efforts are underway to formulate legislative recommendations aimed at advancing energy security in alignment with the goals set during the APEC Leaders Meeting in Kuala Lumpur in 2020. Collaboration is also being fostered to promote affordable energy infrastructure and bolster energy security by leveraging diverse technologies to drive sustainable economic growth.

2. SUSTAINABLE HORIZONS: JAPAN'S TRANSITION TO RENEWABLE ENERGY TECHNOLOGIES AND EVOLVING POLICIES

The speaker of this Session is Professor Yabar Mostacero Helmut Friedrich, University of Tsukuba Japan.

- Japan relies heavily on imported fossil fuels for its electricity, with 77% of its energy supply coming from these sources. To address this dependence and transition to a more sustainable energy future, Japan has committed to reducing its carbon emissions by 1.1 billion metric tons of CO_2. The economy's energy security is currently at 12.1%, and it aims to enhance this security by fostering a resilient energy landscape. Japan's approach to energy transformation is characterized by innovation, technological advancements, and a dynamic policy framework that supports the adoption of renewable energy technologies and adapts to evolving policies. resilient energy landscape for the economy.

- Comparing the primary energy supply in 2010, the fossil fuels usage in Japan was 84.8% of total energy consumption and 3.6% more in 2010, and the renewable energy usage in 2019 was 8.8% of total energy supply and 4.4% more than 2010.
- Japan’s energy outlook for 2030 is generating 0.934 trillion kWh through renewable energy (36%~38%), hydrogen ammonia (1%), nuclear energy (20%~22%), natural gas (20%), coal (19%), and oil (2%). The renewable energy mentioned above includes sources of hydropower (7.8%), solar (6.7%), wind (0.7%), geothermal power (0.3%) and biomass (2.6%). Solar power is the primary force of Japan’s Renewable Energy expansion.
- The renewable energy development also reached 22.7% of total electricity generated in 2022. Nuclear contributes 4.8% of total electricity generation in 2022 and fossil fuels contributed 72.4%.
- The major renewable energy source in 2022 was solar and the hydropower followed.
- Japan started renewable energy FIT (fit-in-tariff) policy from 2012 and caused unbalance renewable energy development. 94.1% of renewable energy was generated by solar.
- The energy self-sufficiency of Japan was 12.1% in 2019, it ranked 35th among major states (Norway; Australia; Canada; USA; UK; France; Germany; Spain; Korea; and Luxembourg), according to IEA report.

- For safety concerns, the basic energy policy elements for 2030 are energy security, economic efficiency and environment (S+3E policy).
- 94% of crude oil was imported from the Saudi Arabia; UAE; Kuwait; Qatar; and Russia in 2021; 90.1% of LNG was imported from Australia; Malaysia; Qatar; USA; Russia; Brunei Darussalam; and PNG. Coals were imported from the Australia; Indonesia; Russia; and USA. The main energy challenges were the grid limitation, oil stocks limitation, GHG reduction responsibilities, high cost of renewable energy, high FIT rates (10%) and utilization of geothermals.
- The renewable energy development targets in 2030 includes: 103.5~117.6 GW by solar; 17.9 GW from onshore winds; 5.7GW from offshore wind; 1.5GW from geothermal, 50.7GW from hydropower and 8GW from biomass. Japan must deploy 4-5.5 GW/yr. in the next decade.
- More than 30 solar power farms (PV farms) has been build in 2021 and they contributed 1377.99MWp capacities. Floating solar PV (FPV) power plants above agricultural ponds provided electricity in 2018 while supporting local farmers in Minamiawaji, West Japan.
- Offshore wind projects in Japan is limited. The main challenges include weak financial position, cost of large-scale offshore wind project and profitability concerns, such as the rising steal price. Japan’s first large-scale offshore wind farm located at Akita was a significant milestone in the economy's pursuit of alternative energy sources. Those 33 wind turbines produce approximately 140 MW per hour.
- Recommendations: Japan should hold oil stocks from imports equivalence of 230 days for domestic supply. The usage of fossil fuels contributes to large amounts of GHG emissions.

3. THE REVIEWS OF OFFSHORE WIND FARM PROJECT DEVELOPMENT STATUS IN CHINESE TAIPEI

The speakers was Dr. CHUNG-HSIEN CHEN, the Director of the Renewable and Prospective Energy Development Division, Energy Administration, MOEA, Chinese Taipei.

- In 2023, Chinese Taipei's energy mix is dominated by fossil fuels, with coal-fired accounting for 42.2%, natural gas (LNG)-fired 39.6%, and oil-fired 1.3%. Renewable energy accounts for 9.5% total and the sources include solar (4.6%), wind (2.2%), and hydropower(1.4%), waste (1.2%), biomass (0.1%) and geothermal(0.008%). Nuclear power provides the remaining 6.3.0%.

- Chinese Taipei’s 2050 Net-Zero Strategy includes : (1) the roadmap to achieve zero emissions and realize our goal by 2050 is published in March 2022. (2) the net-zero transition advocates fundamental change across all sectors of society, and 12 key strategies are proposed to achieve the net-zero goal. The 12 strategies are developing wind and solar PV, utilization of hydrogen, innovative energy promotion, enhancing power system and energy storages, increasing energy savings and efficiency, promotion of carbon capture, utilization and storage (CCUS), using carbon-free and electric vehicles, recycling sources and achieving zero waste target, increasing carbon sinks, promotion of green life, green finance and just transition.
- By 2050, the electricity generated by the renewable energy should reach 60-70% of total electrification.
- The offshore wind projects have the potential to generate 157GW of electricity in the western open sea area of Chinese Taipei.
- Strategies of Offshore Wind in Chinese Taipei includes 3 phases:

- Phase 1, Demonstration Incentive Program (DIP)(2017~2021) with total capacity of 237.2 MW:

- Completed 8MW demonstration turbines at Miao-Li county in 2017.
- Completed DIP wind farms with 237.2 MW in 2021 with subsidies (including the 2 demonstration wind turbines)
  - Formosa 1 at Miao Li county with 128MW
    - 2 wind turbines with 4 MW each ; 20 wind turbines with 6 MW each.
    - Commissioned in 2019 to generate 480GWh electricity annually.
  - Taipower 1 at Chuang-Hua county with 109.2 MW
    - 21 wind turbines with 5.2 GWh capacities each and generates 410 GWh annually。
    - Commissioned in 2021 to generate 410 GWh electricity annually.

- Phase 2, Zones of Potentials (2018~2025).

- Formosa 2 offshore wind farm was commissioned in August 2034 with total 288 wind turbines installed by February 2024.
- Completed capacity allocation in 2018
  - By Selection: 3.836 GW
  - By Auction: 1.664 GW
- Achieving 565 wind turbines installed to generate 5.6 GW in 2025.

- Phase 3, Zonal Development (2026~2035).

- 5 wind farms were delivered and the bidders completed the signatures on the administrative contracts.
- Estimating 1.5 GW to be developed in every year.
  - Round 1 selection in 2022 and plans to build 3 GW between 2026 and 2027.

- Haiding 2 project will allocate 600 MW facilities and achieve commission by 2026.
- Haixia project will allocate 440 MW facilities and achieve commission by 2026.
- Fengmiao project will allocate 500 MW facilities and achieve commission by 2027;
- Formosa 4 project will allocate 495 MW facilities and achieve commission by 2027;
- Huanyang project will allocate 440 MW facilities and achieve commission by 2027;

- 5 wind farms have applied FIT contact signatures in 2023.

- Mid-term goals to achieve 40~55 GW from offshore wind farms in 2050.

- Outlook of Offshore Wind Power: Next Selection Mechanism and Reviewing Process
  - The R3.2 selection mechanism had been announced on November 23, 2023.
- The maximum capacity for each single wind farm project is 500 MW.
- Different capacity caps according to the order: First position: 900 MW; Second position:700 MW; Other positions: 500 MW. Additional 100 MW for a single application.
- Industrial Relevance Plan (IRP)
  - Manufacturing: 20; Technology service: 4。
  - Minimum score is 70 points; items and quantity are optional for developers.
  - The new Reviewing Process
- Capability review on technical capabilities (60%) and financial capabilities (40%), and the score must exceed 70 points.

- Industrial Relevance Plan (IRP) score must exceed 70 points.
- Bidding procedure:
  - Allocation is determined by bidding price.
  - If the bidding price is the same, priority is given to those with the highest IRP score, and those with the same score will be determined by drawing lots.
  - Allocate capacity according to the order.
- Floating Offshore Wind Demonstration Program (draft)
  - Scale requirement: current draft designed as 6-12 floaters for each single application.
  - 2 cases/projects will be approved, with 1 additional case if appropriate.
  - Qualifications: developing area must avoid the sensitive sea areas; Environmental Impact Assessment (EIA) must be completed and approved by the EPA.
  - Review items:
- Technical capability
- financial capability, and
- domestic collaboration.
  - Business Model of Floating Offshore Wind Program: FIT System and CPPA system
- FIT (fit-in-tariff) System
  - Floating offshore wind projects collect financial sources from the financial institution, and the electricity generated by the project will sale to Taipower company through FIT(feed-in-tariff) mechanism.
- CPPA (Corporate Power Purchase Agreement) System

        - Financial institutions provide financial support to the floating offshore wind projects and the electricity generated by the project will sale to corporate/off-takers directly by paying CPPA price.
- Signing CPPAs with multiple off-takers can diversify the commercial risks of power purchasing, attract financial institutions to participate in the renewable energy, and enable more off-takers to purchase sufficient green power.
- Credit Guarantee Mechanism
    - The off-takers have become the guarantee recipients of Credit Guarantee Mechanism
- In order to reduce the risk of project financing, a Credit Guarantee Mechanism has been provided to cover the power purchase costs when off-takers are unable to pay, with a maximum of USD8 billion guarantee amount for an enterprise and 20 years guarantee period.
- Conclusion
    - Confronted with a high dependence on imported energy, a net-zero transition plan aids in bolstering energy independence. We promote collaboration between domestic and international industries to ensure the sustainable development of offshore wind power in Chinese Taipei.

4. THE REVIEWS OF OFFSHORE WIND FARM PROJECT DEVELOPMENT STATUS IN THE PHILIPPINES

- Mr. Carlo Chen-Delantar is Head of ESG and Circular Economy, Gobi Partners Philippines. The Philippines has ambitious targets in its energy plan but falls short in solar and wind capacity. There's a lack of clarity on phasing out fossil fuels. To meet the Paris Agreement, it needs to accelerate efforts by adding more solar energy and phasing out coal and natural gas by

2040. Despite securing funding and setting ambitious targets, the Philippines' current solar and wind capacity of 2 GW is far below the required 344 GW by 2050, with the absence of a clear fossil fuel phaseout plan from the government. To align with the Paris Agreement's 1.5°C goal, the economy must expedite efforts by adding 221 GW of solar energy and implementing a coal and natural gas phase-out by 2040, emphasizing the importance of swift policy implementation and increased investment in renewable infrastructure for success.

- Investment focus sectors are the electric vehicles, smart lighting, outsourced semiconductor assembly, green metals, high-tech agriculture, renewable energy, and data centers/telco infrastructure.
- The Philippines' key industries for approved investments are electricity, manufacturing, and health services, with foreign investment approvals totaling PHP 757.33 billion (USD 13.5 billion), primarily from Germany and the Netherlands. The economy aims to become Southeast Asia's second-largest FDI destination by the end of President Marcos Jr.'s term, targeting PHP 1.3 trillion to PHP 1.5 trillion (USD 23.2 billion to USD 26.7 billion) in approvals. Despite falling short of its PHP 1.5 trillion (USD 26.6 billion) target in 2023, the BOI is working to expedite licensing under Executive Order 18.
- Laws on Investment in the Philippines are followings:
  - (1) Omnibus Investment Code of 1987 and the Foreign Investments Act of 1991;
    - Regulates investments and incentives in the Philippines through the Department of Trade and Industry
  - (2) Republic Act No. 11032;

        - Anti-Red Tape Authority (ARTA) is a government agency established under RA No. 11032 to enforce and oversee compliance with anti-red tape and ease of doing business policies in the Philippines.
    - (3) Republic Act No. 11966 (The PPP Code of the Philippines);
        - This Act streamlines PPP legal frameworks, project approval processes, and introduces a reliable tariff system, enhancing PPP institutions and making other reforms.
    - (4) The Tax Reform for Acceleration and Inclusion (TRAIN) Law.
        - Aims to simplify the tax system, reduce income tax rates for individuals, lower corporate income tax rates, and make the tax structure more equitable.
- Renewable Investment Opportunities in the Philippines
    - The Philippines welcomes 100% foreign ownership in renewable projects, aiming to reduce costs and expand cleaner energy access (DOE Circular No. 2022-11-0034, Nov 15, 2022)
- The Philippines vigorously promotes foreign investment in its renewable energy sector by enacting legislative reforms and establishing a strong incentive framework, positioning itself as an attractive destination for those fostering the advancement of a sustainable and prosperous industry. Six key Reasons for Foreign Investment on the Philippines' RE Sector.
    - Legislative Reforms RA 11659 allows 100% foreign ownership in specific sectors, including renewable energy;
    - Elimination of Economy’s Requirements
    - Catalyst for Investment Reforms attract greater foreign investment, fostering economic growth.;

- Incentive Framework RA 9513 and SIPP offer incentives like income tax exemption and duty-free equipment importation.
- SIPP Alignment with CREATE Act SIPP offers tax breaks and a 5% corporate tax rate, luring investors.
- Flexibility for Export Activities SIPP's flexibility makes the Philippines attractive to investors.

- In 2023, the ASEAN witnessed a substantial increase in its wind and solar energy capacity, with a growth rate of 20%. This expansion brought the total capacity to over 28 gigawatts (GW). Viet Nam emerged as the leading economy in ASEAN for utility-scale solar and wind power, followed by Thailand and the Philippines. Looking ahead, ASEAN has a robust pipeline of announced and pre-construction utility-scale wind and solar projects, totaling 222 gigawatts (GW). A significant portion of this prospective capacity, amounting to over 185 GW, is concentrated in Viet Nam and the Philippines. This indicates that these two economies are likely to spearhead renewable energy development in the region. Furthermore, offshore wind projects are a major focus of ASEAN's renewable energy initiatives. Over 80% of the prospective capacity is from planned offshore wind projects, with a notable concentration in the Philippines and Viet Nam. This emphasis on offshore wind reflects the region's commitment to utilizing its natural resources to meet its energy needs sustainably and contribute to global efforts to combat climate change by reducing reliance on fossil fuels.
- In 2022, the energy supply in the Philippines is 61.6 million tonnes of energy including 31.6% of imported oil, 18.6% of imported coals, 4.2 % of local produced natural gas, 12.4% of local produced coals and 31.9% of renewable energy (geothermal, biomass, ethanol and hydropower). The Philippines aims for energy self-sufficiency, with a self-sufficiency rate of 51% in 2021, indicating a surplus in energy production relative to consumption.

- Overview of Renewable Energy Service Contracts (RESCs)
    - From 2010 to 2022, the installed capacity of renewable energy increased from 5,439MW to 8,264MW. To reach the target capacity of 15,234.3 MW by 2030, an additional 6,979 MW needs to be installed.
- As of November 2023, 1,186 Renewable Energy contracts were awarded by the Department Of Energy, the Philippines. Only 5.7GW out of the total potential capacity of 132.9GW have been installed. Only 17% (183 projects) of awarded RESCs were completed.
- The Department of Energy predicts an astounding 5,497.93 MW potential for solar energy projects from 2023 to 2028. Projected solar capacities are set to surge, with 554.54 MW anticipated in 2023, followed by significant increases to 2,875.57 MW in 2024 and 1,162.36 MW in 2025. Subsequent years are also promising, with 539.54 MW projected for 2026, 365.62 MW for 2027, and 181.2 MW for 2028.
- As of 31 May 2023, potential onshore wind projects for the next six years total 5,532.4 MW. The current existing wind farm is equipped with a total of 634.9MW installation capacities.
    - Roadmap for Offshore Wind Power Development
        - 2022 to 2023 Framework elements include (1) establishing Marine Spatial Planning; (2) designing Offshore wind development zones; (3) Leasing and permitting (including ESIA); (4) Auction arrangements; (5)Capacity building in stakeholders; (6) organizing a government-industry task force.
        - 2022-2028, Developing first project and starting facilities installation, involving project designing, permit system establishing, auction and construction.

- Long-term infrastructure development, including establishing transmission, ports, supply chain and pipeline of offshore wind projects.
- Targets:
  - Attain 3GW~21GW offshore wind capacity by 2040, comprising 21% of the economy's electricity supply.
  - Contribute $1.1 billion(Php 61.6B)~$14.4 billion(Php 807B) to the Philippine economy in local gross value added by 2040.
  - 15,000 ~ 205,000 full-time employment years created by 2040.
  - Offshore wind could prevent 41M tones ~200 million tons of carbon emissions by 2040.
- Potential offshore wind development zones are Guimaras Strait Wind Power Project, Aprarri Bay WPP, Guimaras Straight II Wind Project, Frontera Bay WPP, and San Miguel Manila Bay WPP.
- Renewable energy policies and programs include:
  - FIT (Feed-in-Tariff): The FIT policy offers fixed payments per kWh from new renewable sources for 20 years, driving installations of solar, wind, and biomass.
  - Net-Metering Program: The Net-Metering Program allows end-users to generate up to 100 kW of electricity for personal use.
  - Energy Regulatory Commission (ERC) Issuances: ERC Issuances adopted Net Metering Rules, streamlined the interconnection process and reduce installation costs.

- Preferential Dispatch: FIT-eligible RE units prioritize the Wholesale Electricity Spot Market (WESM) schedule.
- Renewable Portfolio Standards (RPS) – On Grid and Off-Grid: Mandated Participants (MPs) to source a specified portion from RE.
- Green Energy Option Program (GEOP): Allows end-users (>100 kW average peak demand) to choose RE Power Suppliers.
- Renewable Energy Trust Fund (RETF): Established under Section 28 of the RE Act, serves specific purposes related to RE promotion and development.
- Omnibus Guidelines for RE Contracts and Developer Registration: Aims to harmonize and enhance guidelines for RE Contracts and Developer Registration.

■ Incentives for RE Developers:

- ▪ Under the Renewable Energy Act of 2008 and the CREATE Act certified developers enjoy incentives like tax holidays, special corporate income tax rates, and more.
- ▪ Renewable Energy Act of 2008
    - 7-year 4 to 7 years 5% additional 10% and 20% 50% 50% 50% 100% first 3 years 10% 0% VAT income tax holiday Duty-free importation of RE machinery, equipment, and materials Special realty tax rates on equipment and machinery Net operating loss carryover for the Corporate tax rate of Accelerated depreciation if ITH is not granted before full operation rate on RE-generated fuel or power sales

Tax exemption on carbon credits Cash incentive for Missionary Electrification based on cash generation Tax credit on domestic capital equipment and services Exemption from universal charge Option for transmission and wheeling charges based on per kilowatt-hour rate.

- Corporate Recovery and Tax Incentives for Enterprises Act ("CREATE")
    - Income Tax Holiday (ITH) Special Corporate Income Tax (SCIT) based on Gross Income Earned, in lieu of all economy's and local taxes- 5 to 10 years Duty exemption on importation of Capital Equipment, raw materials, spare parts, or accessories VAT exemption on importation and VAT Zero-rating on local purchases depreciation allowance for buildings, and for machineries and equipment respectively additional deduction on labor expense additional deduction on domestic input expense and on power expense additional deduction on R&D, and training expense Deduction for reinvestment allowance to manufacturing industry – the amount reinvested to a maximum of Enhanced Net Operating Loss Carry-Over.
- Executive Order 18: Constituting Green Lanes for Strategic Investments
    - Streamlined approval of permits and licenses for strategic investments
    - Covers government agencies, GOCCs, instrumentalities, and LGUs

    - Aims to attract foreign investments by simplifying bureaucratic processes
  - 2022 Strategic Investment Priority Plan: Includes projects for environment, climate-change related projects, energy, and green ecosystems
  - Executive Order 21: Policy for Offshore Wind Development:
    - Speeds up offshore wind projects with streamlined permits and leasing fees.
    - Agencies must submit permits in 60 days via EVOSS.
    - Aims for 35% renewable energy by 2030, 50% by 2040.

5. INDONESIA TOWARDS SHIFTING THE CONVENTIONAL ENERGIES TO NEW &RENEWABLE ENERGIES

This session invited Professor & Dr. DWI SUSILANINGSIH and her TEAM, The Research Center For Applied Microbiology, Life Sciences & Environment Organization, Indonesian Research & Innovation Agency [Brin].

- Conventional energies in Indonesia
  - Transportation and industry sectors consumed most of energy with total 593.6 million tones, however, the annual energy storage amount was 10.9 billion barrel of oil in 2017.
  - Primary energy resources are coal (38.04%), crude oil (31.6%), natural gas (19.16%), and renewable energy (11.2%) in 2020. The 2050 energy development target includes reducing the coal usage rate to less than 25% less than the 2020 usage rate, reducing crude oil usage to 20%, increasing

natural gas usage to 24%, and increasing renewable energy to 31% more by 2050.

- New and renewable energies
  - The Indonesian government plans to increase renewable energy usage to 23% by 2025. Renewable energies include geothermal (4.607 MW), hydropower (8.01 MW), nuclear energy (1.335 MW), solar(0.907 MW), wind(0.855 MW), biomass (0.795 MW), ocean (7 MW) and diesel oil (2.451 MW) with total 16.715 MW in 2019-2028.
  - Regulations for renewable energy (RNE)
    - Republic of Indonesia Law No. 30 of 2007 concerning Energy, 2007)
    - Economy's Energy Policy (KEN)
    - Republican Government Regulation Indonesia Number 79 of 2014 concerning Economy's Energy Policy, 2014
      - the target in 2025 is that the role of New Energy and Renewable Energy will be at least 23% and in 2050 at least 31%.
    - Regulation of the Minister of Energy and Mineral Resources of the Republic of Indonesia No. 50 of 2017 concerning the Utilization of Renewable Energy Sources for Providing Electricity, 2017
    - Regulation of the Minister of Energy and Mineral Resources of the Republic of Indonesia No. 38 of 2016 concerning the Acceleration of Electrification in Undeveloped, Remote, Border and Small Islands Villages Through the Implementation of Electricity Supply Businesses, 2016)

        - Republic of Indonesia Law No. 16 of 2016 concerning Ratification of the Paris Agreement to the UN Framework Convention on Climate Change), 2016

- Wind Power
    - Indonesian wind energy has a potential of up to 60.65 GW.
    - total potential of commercial marine wind energy in the archipelago is 1,323 MW.
        - coastal areas (onshore) potential: 842.75MW.
        - offshore potential: 500 MW on Java island; The remaining 342.75 MW is spread across Sumatra, Sulawesi and Maluku.
    - With various problems, the development of wind energy—not even offshore—in Indonesia's coastal areas has not made significant progress.

- Solar Power
    - a potential of indonesian solar energy was 207.898 MW

- Geothernal energy
    - Law No. 21/2014 on Geothermal
    - Law No. 27/2003 on Geothermal
    - Government Regulation No. 59/2007, with addendum Government Regulation No.70/2010 on Geothermal Enterprise
    - Ministerial Regulation : •Ministry Regulation No. 005/2007 on the Guidelines for Geothermal Preliminary Survey Assignment.
    - Ministry Regulation No. 11/2008 on the Mechanism for Determining of Geothermal Working Area.

- Ministry Regulation No. 2/2011 on Based price for Electricity produced by Geothermal Plant (this regulation provides a detailed explanation on how PLN should buy power from geothermal producers, including a clause ordering the company to refer to the reference price of 9.7 US cent per kilowatt hour (kwh)).
- Ministerial Regulation of MEMR No. 22/2012 on geothermal price structure.

- Hydropower
  - Existing hydropower
    - 15,600 Megawatts (20.8%) in Sumatra
    - 4,200 Megawatts (5.6%) in Java
    - 21,600 Megawatts (28.8%) in Kalimantan
    - 10,200 Megawatts (13.6%) in Sulawesi
    - 620 Megawatts (0.8%) in Bali, NTT, NTB
    - 430 Megawatts (0.6%) in Maluku
  - The total hydropower potential that Indonesia has is 75,000 Megawatts and currently only 10.1% or 7,572 Megawatts of the total existing potential have been utilized.
    - Papua, have hydropower potential of 22,350 Megawatts or 29.8% of the economy's potential.
- Biomass Energy
  - The total biomass energy potential that Indonesia has more than 1,160 Megawatts energy, including plymill, sawmills, sugar mills, palm oil mills and rice mills.
  - Area: Java, Sumatera, Kalimantan, Sulawesi and Irian Jaya.

- Hydrogen energy
  - Using hydrogen energy and reaching 10 MW by 2025-2030
    - Demonstration of small-scale green hydrogen production
    - Replacement of gray hydrogen with green hydrogen in industrial processes
    - Small-scale hydrogen utilization at commercial level
    - Small scale hydrogen pilot project for cofiring
    - Green hydrogen demonstration (diesel blending, fuel cell, etc.)
    - *Demonstration of blue hydrogen for mobility
  - Reaching 5 GW by 2031-2035
    - Adoption of green hydrogen production on a large-scale Use of hydrogen in the electricity generation sector;
    - Development of liquid hydrogen storage at pilot scale Support through grants, rates and other schemes;
    - Preparing to export hydrogen to other economies (Asia) Utilization of geothermal for green hydrogen production;
    - Adoption of hydrogen storage at scale
  - Reaching 20 GW by 2036-2040
    - Cessation of fossil based hydrogen production, except for those equipped with carbon capture. Largescale hydrogen exports to other economies Hydrogen infrastructure development (storage, transportation, filling stations, etc.)

- Hydrogen can contribute around 1- 5% of total energy consumption in Indonesia Use of hydrogen for heavy vehicles.

6. THE MARINE EIA AND OFFSHORE RENEWABLE ENERGY POLICY REVIEWS AND PROJECT DEVELOPMENT IN AUSTRALIA

This session invited Dr. Maya Malik, Co-founder of KIMA Energy to explain and introduce the offshore wind developments and the related regulations. It also covers the reviewing and auction procedures. Maya's extensive 20-year career in the energy sector, with a focus on leadership, strategic, and commercial roles, positions her as a seasoned professional. Her expertise is particularly notable in the offshore wind industry, where she has worked on projects across Australia, Asia, the UK, and Europe. Maya's influence extends beyond project management; she serves as an advisor to the World Bank's offshore wind development program and has been recognized as one of the top 35 most influential women in the global wind power industry, ranking among the top 3 in the Asia-Pacific region, for her pivotal role in establishing the offshore wind sector in Chinese Taipei and Viet Nam.

Prior to founding KIMA, Maya held several high-level positions with Danish developers Copenhagen Offshore Partners and Ørsted. Her experience encompasses the entire offshore wind project lifecycle, including leading market entry and bidding processes, managing joint ventures, directing projects, overseeing technical teams, and managing the setup and operation of several gigawatts of offshore wind assets. Before transitioning to renewable energy, Maya worked on large-scale petrochemical projects for Shell in Australia, the Netherlands, and Singapore. She holds an MBA from INSEAD and a Bachelor of Mechanical Engineering degree from Curtin University in Western Australia, demonstrating a strong educational foundation in engineering and business management.

- Overview of offshore wind in Australia
    - Potential covers whole economy, however, government has announced 6 specific ‘declared areas’ for the development of OSW in the states of Victoria, New South Wales and Western Australia. Victoria state established the development of 2 GW from OSW by 2032. The first site was awarded in 2023 but the first power could be generated in 2028 from the first project.
    - Australia laws to promote OSW: Offshore Electricity Infra Act 2021 ◦
    - There are no specific PPA schemes available for offshore wind (OSW).
    - Currently, RE projects negotiate bilateral PPAs with energy retailers/ corporates or sell power directly to the wholesale market.
    - The development path for offshore wind in Australia is promising, supported by a positive political climate under the current Labour government, which aims to position the economy as a renewable energy superpower. The state of Victoria has made the most significant progress in offshore wind development, with ambitious targets set to reach 9 gigawatts (GW) by 2040. Despite a relatively stable power demand that has remained flat since the 2000s, plans to phase out coal-fired power stations by around 2030 and the expected increase in power demand due to electrification are driving the need for additional renewable energy sources. The outlook for offshore wind in Australia is optimistic, although there are ongoing discussions about the best approach to market integration and the potential scale of the industry outside of Victoria Province.
- To get site exclusivity, developers must select a site within a Declared Area and submit a Feasibility License application to government. Government

will assess applications based on developer technical & financial capability and project viability, as well as ‘economy’s interest’

- Historical development of offshore wind
    - Australia starts the OSW quite late. Government awards an Exploration License to an offshore wind project to perform survey works in 2019. Offshore Electricity Infrastructure (OEI) Bill passed in 2021. It establishes a new framework for offshore wind projects. Central government announces first ‘declared area’ in Gippsland Victoria as first region for offshore wind in 2022 and announces 4 more ‘declared areas’ in Hunter Valley, Portland, Illawarra, Tasmania, and commits to announce a final area in Western Australia in 2023.
    - Following the regulations and policies from the central government, Victoria announces clear offshore wind targets of 2GW by 2032 (1st power 2028), 4GW by 2035, 9GW by 2040 in their ‘Offshore Wind Policy Directions Paper’ in 2022; Feasibility License applications open for Gippsland and Hunter Valley. Victoria committed to harbor upgrades and a ‘Revenue Support Mechanism’ for offshore wind in 2023. First Feasibility license in Gippsland will be announced soon in 2024.
- Australia OSW project approval process
    - Australia’s first Feasibility Licenses will be awarded in ~March 2024 with four phases: Area release, Site exclusivity, Development approval, Construction approval and Project Financial close phases. The reviewing process might took 1~7 years.

- Area release/ Aera declaration & site exclusive process could also belongs to "feasibility license" award process. Area release procedure involves: (1) Government prioritises regions based on wind resource, demand centers, existing port infra and developer interest; (2) Government selects seabed area and holds a 3-month public consultation; (3) Selection assessment considers other users, marine traffic, social & environmental impact, defense areas, radar operations, other infra etc.; (4) Minister considers consultation feedback and declares areas suitable for development under OEI framework; (5) Declared area(s) announced via public notice; (6) Competitive process held to award Feasibility Licenses.

- Feasibility license phase: License to enable feasibility work to inform future project (2) License has a 7-year term; (3) Only once license per area, max area of 700km^2; (4) Awarded via competitive process, based on merit criteria: technical capability, financial capability, project viability, applicant suitability and economy's interest; (5) Annual fee is payable upon receipt of license; (6) Any overlap of application areas will be decided by the Minister (merit based or a financial offer could be requested); (7) After the license is issued, any change of control (holding of >20%) must be approved by regulator.

- Development approval phase contains Environmental approvals, Land agreements and Revenue Support Mechanism.

- The applicant has to conduct environmental impact survey and main works, both works has to be awarded by the Federal and state governments. Agreements with land owners to acquire onshore land is necessary.

- Offtake support from state government, awarded via a competitive process

▪ Construction approval phase

- Management plan approval: Regulator approval of HSE, construction, ops, decommissioning and stakeholder management plans.

- Commercial license: (1) 40 year term; (2) Transmission and Infra license granted; (3) Contingent on final investment decision / financial close; (4) Annual fee payable upon receipt of license.

o Key regulations for development and environmental approvals

▪ Key Commonwealth legislation

- OEI Act (development approvals)

- EPBC Act (environmental approvals)

- Specific regulations on threatened species

- Native Title Act

- Underwater Cultural Heritage Act

▪ Key state legislation

- Environmental Effects Act
- Planning & Environment Act
- Aboriginal Heritage Act
- Traditional Owner Settlement Act
- Marine and Coastal Act
- Heritage Act

7. PROBLEM SHOOTING ON THE COMBINATION OF OFFSHORE WIND POWER AND FLOATING PV IN THE OPEN OCEAN

This section invited Dr. Yiyuan William Su from TAEF, Chinese Taipei.

- Advantages of Oceanic FSPV
  - The cost of acquiring land for solar energy installations is on the rise, particularly in economies where land resources are scarce. However, floating solar photovoltaic (FSPV) installations offer several advantages, including lower acquisition and development costs, and the ability to utilize open water surfaces that would otherwise be underutilized.
  - FSPV installations are also more ecologically friendly, as they do not require the use of land that could be used for agriculture or other purposes. Additionally, the use of water for FSPV installations can help to reduce the temperature of the panels, which can improve their efficiency and increase electricity generation.

- The cooling effect of water can also help to prevent evaporation, making FSPV installations a more sustainable option for power generation. Furthermore, the combination of FSPV with other renewable energy technologies, such as wave power, offshore wind, and pumping, can help to create more stable and efficient electricity generation methods.
- The regulatory requirements for FSPV installations in oceanic environments are also generally more relaxed than those for land-based solar installations, which can further reduce the cost and increase the feasibility of these projects.

- Elements of Oceanic FSPV
    - Anchoring
    - Mooring lines and cables
    - Floaters/Pontoons
    - Lightning protection system
        - Metal frames supporting modules and grounds
    - Combiner boxes
    - PV modules
    - Inverters
    - Transformers
    - Transmissions
- Structure designs
    - There are two primary types of oceanic FSPV system designs: rigid structures and flexible structures. Rigid structures are typically more robust and can withstand harsher environmental conditions, but they can be more expensive and time-consuming to

install. In contrast, flexible structures use an elastomer deformation mechanism to reduce the interaction between the wave floating platform and the panels, which can reduce the specifications of the cable and material strength.

- One advantage of the modular floating platform design is that it can significantly shorten construction and installation time. However, the use of interconnected connectors in these designs can also lead to increased stress on these components, which can correspondingly increase material and maintenance costs.
- Despite these challenges, one significant benefit of FSPV installations is that the panels benefit from direct contact with water, which can effectively reduce the temperature and improve efficiency. This advantage is not available with land-based solar installations, making FSPV a more attractive option for power generation in many regions.

- Problems of Oceanic FSPV
  - Oceanic FSPV installations can contribute to pollution in several ways. For example, the buoys used in these installations are often made from polyethylene (PVC), which can break down into microplastics and contribute to marine microplastic pollution. Additionally, the disposal of used panels and modules can be a significant environmental concern, as these materials are not always easily recyclable.
  - Extreme weather events such as typhoons and tsunamis can also pose a significant challenge to FSPV installations, as they can cause damage to the panels and other components. To address these challenges, new technologies are being developed, such as metal coatings that provide corrosion resistance, which can help to reduce maintenance costs and extend the lifespan of the installations.

    - Despite these challenges, there are also opportunities for innovation and cost reduction in the materials and technologies used in FSPV installations. For example, the use of magnesium alloy can provide excellent corrosion resistance, which can help to reduce maintenance costs and extend the lifespan of the installations.
    - However, the upfront cost of FSPV installations is typically higher than that of land-based projects, due to the need for advanced equipment and the challenges of installation in open water. Additionally, the vast scale of these installations can limit their usage in some regions, and the high investment required can lead to low returns on interest.
    - Finally, FSPV installations can also have environmental impacts on marine life, such as seagulls and other birds that may inhabit or nest near the installations. The guano produced by these birds can also shield the system and increase maintenance costs. These challenges highlight the need for careful planning and design of FSPV installations to minimize their environmental impact and maximize their benefits.
-
- Hybrid or multiple facilities combination of offshore energies
    - The acquisition of permits and licenses is a critical aspect of any oceanic FSPV project. This includes obtaining the right to use the marine spatial area where the installation will be located. In some cases, this may involve separate applications for different aspects of the project, while in others, it may be possible to apply for a comprehensive permit that covers all aspects of the project.
    - Another important consideration is the impact of the project on fishery rights. FSPV installations can disrupt traditional fishing areas and methods, which can lead to conflicts with local fishing

communities. It is important to address these concerns through consultation and collaboration with local stakeholders to ensure that the project is supported and that the rights of all parties are respected.

  - The integration of different systems and structures is also a critical aspect of FSPV project design. This includes the need to ensure that the installation is structurally sound and can withstand the challenges of the marine environment, including extreme weather events and other natural hazards.
  - Finally, the safety of workers and other personnel involved in the project is a critical consideration. This includes the need to comply with different safety standards and regulations, which can vary depending on the location and the specific circumstances of the project. It is important to ensure that all personnel are properly trained and equipped to work safely in the challenging marine environment.

8. ESTABLISHING THE OFFSHORE SOLAR FLOATING SYSTEM

This section invited Miss. Mei-Lin Kuo, the Sale Manager of the Sun Rise E&T Co. Chinese Taipei.

- The reason to use a floating solar photovoltaic (FSPV) system is because it could generate additional power and resolve the land limitation problem on renewable energy development.
- The current FSPV application on river, lake and reservoir.
  - wind-solar-aquaculture co-construction to create a commercial-ecological win-win solution.
  - Small maritime areas can implement large-scale solar PV.

- Scalable Modular Design could be expanded up to 100 MW per block.
- Most cost-effective renewable energy on land, and soon for offshore.
- Simple marine installation process, plus shared facilities with offshore wind system.
- The FSPV installation will not cause landscape impacts because the modular is 6 km away from shore.

- Challenge of Going Offshore
  - Short of operation and maintenance window;
  - Lacking of monitoring system;
  - Problem on power grid connection;
  - Material longevity;
  - Structural integrity;
  - Lacking of reference.
- Floater material - HDPE PE100
  - Bracket and pipe are made by the HDPE PE 100, it owns highly flexibility and can tolerate wide range of temperature (above or minus 60 degrees Celsius).
  - The materials used in oceanic FSPV installations must be highly resistant to UV radiation, which can degrade the performance and lifespan of the panels and other components. The ideal materials should be able to withstand exposure to UV radiation for 50 to 100 years without significant degradation, ensuring that the installation can operate efficiently and effectively over the long term. This requires the use of high-quality materials and advanced

manufacturing techniques to ensure that the installation can withstand the harsh marine environment and provide reliable power generation for decades.

- Racking and Module Material
    - The use of ultra-durable panels is a critical aspect of ensuring the long-term performance and reliability of oceanic FSPV installations. These panels are designed to be highly resistant to wind and corrosion, with a PVDF-coated frame that provides additional protection against the harsh marine environment. The panels also feature an insulated super crystalline nanomaterial that is designed to enhance their efficiency and durability. This material is highly resistant to degradation and can withstand exposure to UV radiation and other environmental stresses for 50 to 100 years, ensuring that the panels can operate at peak performance over the long term. The photovoltaic board used in these panels is also designed to be highly efficient and durable, with a structure that is optimized for maximum energy conversion and minimal maintenance requirements. This ensures that the installation can provide reliable power generation with minimal downtime, making it an attractive option for a wide range of applications.
    - The use of an anti-corrosion rack is a critical aspect of ensuring the long-term durability and reliability of oceanic FSPV installations. This rack is made from a newly developed stainless steel alloy known as 446, which is highly resistant to corrosion and other forms of environmental degradation.
    - The material has been tested to the ISO9227 standard Salt Spray Test, which simulates the corrosive effects of saltwater and other environmental stresses. The rack has passed the 10000-hour test

    - with flying colors, and it is expected to complete the 15000-hour test with minimal signs of corrosion or other forms of degradation.
    - This level of durability is essential for ensuring that the rack can withstand the harsh marine environment and provide reliable support for the panels and other components of the FSPV installation. It also helps to minimize maintenance requirements and extend the lifespan of the installation, making it a cost-effective and sustainable solution for oceanic power generation.
    - Bi-facial Module could increase 7% more electicity than traditional installations.
- Micro-Crack Prevention
    - When establishing a connection between floaters and PV modules, utilizing SST 446 as an intermediary serves to mitigate the variances in Coefficient of Thermal Expansion (CTE) among materials. Consequently, diminish the risk of microcrack formation on solar panels.
    - Module Frame is made by 24~26 inches of Aluminum (Coefficient of Thermal Expansion α value); Frame & Clamp is using 446 Stainless Steel; the Floater Structure is made by HDPE 126.
- Buoyancy Control is In between 30-50%, Via controlling buoyancy and area of floater contacting sea water, the growth of barnacle on floater is being restrained.
- Fire Prevention Segregation Waterway
    - DNVGL-RP-0584, Chapter 5.6 & 9.2.4 Floats may need fire-resistant in certain use cases. PV modules should be installed over a fire-retardant or fire-resistant mounting structure.
- Different OFPV structure
    - Pontoon concept
    - Truss concept
    - Soft & flex concept

- Fish farm concept

- There are 8 Offshore floating solar photovoltaic (OFPV) in the world, most of them located in European states.

9. THE SPATIAL MANAGEMENT ELEMENTS ON ESTABLISHING OFFSHORE WIND FARM PROJECT

This section invited Dr. Yiyuan William Su from TAEF, Chinese Taipei.

- The regulations related to the ocean space management
  - Continental Shelf Law
  - The Territorial Sea and the Contiguous Zone Law
  - Coastal land Management Law
  - Fishing Act
  - Civil Aviation Law
- Legislative experiences and comparisons
  - USA
    - In the United States, the development of offshore wind energy is a key component of the economy's renewable energy strategy. The goal is to have 30 gigawatts (GW) of offshore wind energy capacity installed by 2030, and an additional 15 GW of floating offshore wind capacity by 2035. The legal framework for offshore wind energy development in the United States is complex, involving a mix of federal and state laws and regulations. One of the key pieces of legislation is the Submerged Lands Act of 1953, which defines the ownership and jurisdiction over

submerged lands. In general, coastal states have jurisdiction over coastal waters, while the federal government has jurisdiction over the Exclusive Economic Zone (EEZ) and matters related to commerce, navigation, economy's defense, and international affairs.

- The Coastal Zone Management Act (CZMA) and the Federal Land Policy and Management Act of 1976 are also important pieces of legislation that affect offshore wind energy development. Onshore wind projects on federal or federally controlled lands also require some form of permission under the Energy Policy Act of 2005.
- There is currently no federal statute that expressly governs offshore wind energy development, but the Bureau of Ocean Energy Management (BOEM) within the Department of the Interior is the authorized agency for offshore wind energy permitting. The Army Corps of Engineers (Corps) is also involved in the permitting process under Section 10 of the Rivers and Harbors Act (RHA).
- Lease agreements between project developers and the federal government are a key component of offshore wind energy development. These leases grant the lessee access and operational rights to the designated area for the production of energy. Once a lease is granted, the project owner has the exclusive right to use the marine area for the project, from the seabed to the top of the blades, without competition from other projects.
- Environmental regulations also play a significant role in offshore wind energy development. The Economy's Environmental Policy Act (NEPA) requires environmental impact assessments for major federal actions, while the

Endangered Species Act (ESA), the Marine Mammal Protection Act (MMPA), and the Migratory Bird Treaty Act (MBTA) protect specific wildlife species and habitats. Developers must ensure that their projects comply with these regulations to avoid harm to protected species and habitats.

- Norway
  - In Norway, the development of offshore wind energy is supported by the Offshore Energy Act 2009, which was further elaborated in the Offshore Energy Act No. 21 of 4 June 2010. This act establishes the legal framework for the development of offshore renewable energy projects, including wind power.
  - To initiate offshore renewable energy production activities, a license is required for the opening of specific geographical zones. Once a zone is designated for renewable energy production, it will become possible to apply for a license to operate within that area. The license grants the holder an exclusive right to operate within the defined area, subject to the payment of a processing fee.
  - The Norwegian Directorate for Fisheries plays a key role in the licensing process, ensuring that the interests of the fishing industry are taken into account. However, due to the nature of the activities involved, coexistence between fisheries and offshore wind farm operations is generally considered to be impossible.
  - The exclusivity of the license means that once granted, no other party can operate within the same area for the same purpose. This exclusivity is a key aspect of the licensing process, providing the license holder with the security and

certainty they need to invest in the development of offshore renewable energy projects.

- Belgium
  - Belgium's goals for the development of renewable energy include increasing the total offshore wind capacity to 5.8 GW by 2030. Several laws and regulations have been implemented to protect the marine environment and facilitate the growth of offshore wind farms:
    - In 1999, a law was enacted to protect the marine environment in Belgium's sea areas.
    - An Environmental Impact Assessment (EIA) process is in place.
    - Emergency measures for marine protection are established.
    - Penalties are enforced for non-compliance.
    - The Electricity Law of 2012 governs aspects of energy production.
    - In 2012, the Law of 20th January 1999 was amended, leading to the creation of the "Law for the protection of the marine environment and for the organization of marine spatial planning in the sea areas under the jurisdiction of Belgium."
  - Three permits are required for offshore wind farm development:
    - Domain concession, secured by the Royal Decree on Domain Concessions of December 20, 2000, grants the right to use an area for offshore wind farm development.

        - Marine protection permit, governed by the Law on the Protection of the Marine Environment of January 20, 1999, and the Royal Decrees of September 7, 2003.
        - Cable laying permit, regulated by the Federal Act of June 13, 1969, within the Exclusive Economic Zone (EEZ) and the Royal Decree of March 12, 2002.
- Germany
    - Maritime Spatial Planning
        - The Federal Regional Planning Act of 2008 (known as ROG) delineates the responsibilities regarding spatial planning as follows:
            - The Provincial government oversees the Territorial sea.
            - The Federal government has jurisdiction over the Exclusive Economic Zone (EEZ) and the High Seas.
            - Permits issued for non-exclusive or non-domain concession activities.
        - Additional regulations and permits related to maritime development include:
            - The Site Development Plan (FEP) outlines land use planning.
            - The Maritime Facilities Act of 2017 (Seeanlagengesetz – SeeAnlG) governs maritime structures.
            - These regulations encompass offshore hydropower, wave, and tidal technologies.

        - The planning approval permit under the Wind Energy at Sea Act of 2020 (WindSeeG) is required for wind energy installations, cable laying, and dispatch activities.
- Netherlands
    - The Land Use Planning Act (Wet ruimtelijke ordening) and Economy's Water Plan of 2009 incorporate the following provisions:
        - The inclusion of a marine spatial plan.
        - The bidder holds exclusive rights to the specified zone.
    - Furthermore, the Multiple Use Assessment Framework of 2022 introduces:
        - Umbrella permits that allow for multiple use operations within offshore wind farms.
        - Permit holders have exclusive rights to the designated marine area.
- Chinese Taipei
    - Legislation:
        - The Renewable Energy Development Act of 2023
        - The Electricity Act of 2023
        - The Coastal Zone Management Act of 2015
        - The Fisheries Act of 2018
        - Fisheries rights are considered a private right falling under Right in Rem of real property, granting exclusive rights.
    - Administrative Regulations and Directives:
        - Directives for formulating offshore wind power planning site applications in 2015.

- Equating wind farm areas to sea areas.
- Directives for capacity allocation in planning offshore wind power sites in 2021.
- Directives for offshore wind power zone development planning applications in 2021.
- Non-Urban Land Use Control Rules, specifically Article 6 and 6-2.
- Regulations governing land usage in sea areas, requiring permits and classified as Right in Rem of real property (exclusive right).
- Rules for managing specific areas outside primary coastal protection zones.
- Re-evaluation of permissions for offshore land usage in the context of offshore wind power generation systems.

▪ Legal nature of the Territorial Sea Land Contract

- Based on the Article 2 of the “Allocation Regulations of the Income form installation of renewable energy power generation equipment on economy owned property”
    - Definition: The territorial sea lands are economy’s property.
    - Owner of the land under territorial sea: Economy’s Property Administration, Ministry of Finance
    - Offshore PV generator’s right on the land of the wind farm: right to use (civil right).
    - Fee: Monetary reimbursement (compensation).

        - The Spatial Development Agreement of Offshore Wind Power Generation is a lease agreement. The tender owns spatial zoning usage right on the designated territorial sea。
        - Permit equals to "Right in Rem of real property" and also equals to "exclusive right".
    - Conclusion:
        - Only Chinese Taipei does not establish offshore wind power laws among the above 6 economies.
        - Chinese Taipei does not establish Maritime spatial plan yet.
        - The bidders have exclusive right to use sea area among the above 6 economies.
        - Only Chinese Taipei does not allow the bidder to implement hybrid renewable energy facilities in the contractural sea area.

10. LEGISLATING HYBRID MARINE ENERGY IN EUROPE

This section invited Mr. Nate Maynard, the Independent Consultant of sustainability.

- Bottom-fixed wind power reaches commercial operation usage; floating wind and tidal energy are during the technology development stage and facing market uptake. Wave energy and floating solar PV remains early R&D stage development.
- Wind Turbine Wakes and Spacing
    - Wind turbine wakes can extend up to 10km, diminishing the efficiency of nearby turbines and yielding diminishing returns with increased turbine density. To enhance energy output, consider integrating floating solar, tidal, wave, transmission, or storage

technologies. Turbines represent 30% of project costs, impacting overall development. Preliminary findings indicate that floating solar systems outperform land-based installations by 13%."

- Impacts of Offshore Wind
    - Offshore wind projects have various impacts on birds, migratory mammals, and fisheries. Floating solar projects lack comprehensive Environmental Impact Assessment (EIA) studies and long-term monitoring. Initial studies in freshwater areas indicate a slight decrease in dissolved oxygen, reduced wind activity resulting in less erosion, and no immediate adverse effects on fish populations. Regular maintenance is essential for offshore wind installations. Combining maintenance trips for both offshore wind and solar projects can lower costs and increase energy output according to models."
- EU Legislative Frameworks
    - EU Regulations Interacting to Enable Hybrid Energy
        - Renewable Energy Directive:
            - The revised edition (III) introduced a structure for Renewable Energy Go-to Areas (G2As) to expedite environmental permitting by necessitating just one Environmental Impact Assessment (EIA) per parcel at the outset.
        - Marine Strategy Framework Directive:
            - This directive constrains marine development while advocating for higher development density.
        - Spatial Planning Directive:

        - The Spatial Planning Directive propels economies to define energy zones through a Marine Spatial Planning (MSP) framework.
    - Environmental Impact Assessment Framework:
        - This framework is a fundamental part of the permitting process that promotes hybrid projects due to their impact-minimizing benefits.
- Renewable Go 2 Areas
    - RePowerEU – increase 2030 Retarget to 45%
        - Double solar PV and install 600 GW by 2030
    - Amended version (III) set out a framework for renewable go to areas (G2As) speeding up environmental permitting by only requiring one EIA per parcel and that initial.
    - Ukraine was speeding up permitting of renewable projects, fast tracking and combining where possible, in areas with low environmental risk.
- EU-Scores Drives CMRE and more
    - EUR44 million project piloting and modeling large scale CMRE projects across Europe, 9 economy partnership model supporting every dimension of developing sites.
    - A 3 MW grid-connected offshore solar PV system by Oceans of Energy installed 2 km off the Belgian coast at the Blue Accelerator test site. Focuses on the electrical integration in existing infrastructure and the survivability of such a large floating structure.

        - An interconnector between developers and policy, starting in 2025 will partner with utilities to streamline projects across the region.
    - Siting Offshore Wind – Economy Variations
        - Economy differences on project siting can vary widely.
        - BE and NL are the furthest in hybrid project development, clear rules and targets seem to encourage projects.
    - Economy Projects and Case Examples
        - Belgium's Energy Island – World First
            - Princess Elizabeth Island, the world's first "artificial energy island" with 3.5 GW of capacity and will link the UK and Danish electricity markets
            - EIA in process, special considerations required under the Natura 2000 Framework Specific
            - Shipping lanes to the UK
                - • Existing sand extraction
                - • Limiting the environmental impact in the most sensitive areas;
            - Full EIA to be released in 2024
        - The Netherlands: Dutch Offshore Wind Farms Adding Floating Solar
            - "Leading" on Floating Solar
                - NL aims to add 3 GW of floating offshore solar

- Dutch MSP and the Economy's Water Plan 20162021 and the Underlying North Sea Policy Document all promote multi-usage of ocean and coastal spaces
- Dutch policies explicitly state most solar development and targets should be met with roofs and avoid competing with other land-uses.
- A permit, under the Water Act is required for activities involving a fixed structure on the seabed or in the water column, the permit application is followed by an assessment, which considers the impact on North Sea.

▪ United Kingdom: Focusing on Interconnections – Defining New Licenses

- Interconnects First – Other Barriers Remain
    - MSP in place since 2010
    - Currently revising licensing and permitting for hybrid offshore assets, starting primarily with interconnections but including other types of multi-use spaces
    - Legal gap around offshore sites with multiple-uses: how to insure, tax, and manage multi-use spaces?
    - In 2023 UK curtailed 3,700 GWh of wind power, massive grid challenges.

        - Significant grid challenges stalling all types of future RE development, deprioritizing new projects over grid connections and storage.

- The United States: Slow Offshore Wind Development and Permitting Challenges Delay Advances
    - USA Lacks Overarching MSP and Offshore RE
        - As of 2022 installed capacity of offshore wind is 0.04 GW, first tender released in 2010.
        - Numerous blocks of initial sites slowed industry, while other RE options remained much cheaper.
        - The 2030 Offshore Wind target of 30 GW of capacity established under the Biden Administration likely wont be met.
        - There is no overarching legal framework for MSP across the United States.
        - No offshore floating solar.
        - Consistent policies across states, supply chain development, and legal frameworks for MSP would help enable CMRE along USA coasts.
- Economy Observations
    - MSP sets the framework and guardrails for developing offshore RE, however, planning alone

will not lead to hybrid projects or incentivize developers.

- RE targets alone do not guarantee offshore energy when suitable land-based alternatives exist, or other factors limit development.
- Hybrid offshore energy systems vary based on local conditions and priorities.
- A robust research and engagement network can lead to pilot sites which decreases risks and encourages developers.
- Geopolitical concerns combined with climate commitments can incentive projects.

▪ Recommendations for APEC Based on European Legislation

- Establish the Fundamentals Around Legal Frameworks
    - Consider Renewable Go To Areas as a way of speeding up permitting
- Look to Recent EU Policies
    - Limited marine development, encourages density
- Provide Flexibility in Project Sites and Legislations
    - MSP framework driving economies to establish energy zones.
- Relax Permitting When and Where Possible.

- Essential process for permitting that encourages hybrid projects as they minimize impacts.

- Develop Projects Based on Local Constraints and Opportunities
  - Netherlands limits solar on land, Belgium and UK value interconnects, experiment!

11. OFFSHORE WIND FARMS THAT BALANCE WITH NATURE

This section invited Miss Chih-An Lee, Senior Sustainability Advisor, Ørsted.

- Key Steps in Ørsted's Transformation to a Green Energy Major:
  - 2012: Transformation Plan Initiated
    - The transformation plan commenced in response to strong financial pressure and a negative business outlook.
  - 2016: Ørsted IPO
    - Ørsted went public with an Initial Public Offering (IPO) and undertook a restructuring of its business, focusing on stronger financials and exiting oil and gas activities.
  - 2017: Name Change and New Vision
    - The company changed its name from DONG to Ørsted and established a new vision to create a world powered entirely by green energy.
  - 2017: Exit from Oil & Gas

- Ørsted divested its upstream oil and gas activities to INEOS and sold its liquefied natural gas activities to Glencore.

  - 2019: Power Distribution Divestment

    - Ørsted completed the divestment of its power distribution business.

- Ørsted's Energy Systems Development Overview:

  - Ørsted aims to create green, independent, and economically viable energy systems.
  - As a global leader in offshore wind, Ørsted develops, constructs, operates, and owns offshore wind farms.
  - The company has set an ambitious goal to achieve around 30 GW of installed capacity in offshore wind by 2030.
  - Ørsted has a presence in Europe, including bioenergy plants, legacy gas activities, and patented waste-to-energy technology.
  - Ørsted owns and operates bioenergy and waste-to-energy plants while optimizing its gas portfolio.
  - With a strong presence in the United States and Europe, Ørsted develops, operates, and owns onshore wind, solar PV, and storage projects.
  - The company aims to achieve approximately 17.5 GW of installed capacity in onshore renewables by 2030.
  - Ørsted's portfolio includes offshore wind, onshore renewables, bioenergy, and other projects.
  - The company has an emerging platform with 10 pipeline projects (totaling over 3 GW) primarily in Europe.

- Ørsted is involved in developing, constructing, owning, and operating hydrogen facilities.
- Ørsted's ambition is to become a global leader in renewable hydrogen and green fuels by 2030.

- Out local footprint: The Greater Changhua Offshore Wind Farms
  - Capacity installation is 1.82GW and able to power households of 2 Million.
- The Ørsted Vision: Create a world that runs entirely on green energy
  - At a glance | Sustainability at Ørsted 6 At Ørsted we aspire to run a business that gives more to nature and society than it takes. Our actions should contribute to fully decarbonizing the world's energy systems while also creating a lasting positive impact on our environment and societies.
- Why do we pursue biodiversity net-positive impact?
  - We need a scale-up of renewable energy to accelerate the transition to green energy.
  - We believe the Climate and Biodiversity crises must be solved together, as they are intrinsically linked • We care about the environment we do business in and want it to thrive • Because of our global footprint and presence offshore, we see ourselves as stewards of the ocean.
  - Our stakeholders expect a robust and reliable reporting scheme on Net Positive Impact (NPI)
- Protecting biodiversity begins with the mitigation hierarchy
  - Avoid:

- Avoid disturbance of biodiversity from the outset during development.
- Ørsted example: Avoidance of sensitive habitats for on offshore cable routes.

- Reduce & Mitigate:
    - Aims to minimise or eliminate impacts on sensitive habitats and species.
    - Ørsted example: Using noise mitigation technology (bubble curtains) during installation.
- Restore
    - Compensates for residual biodiversity loss from development projects and contributes to achieving No Net Loss.
    - Ørsted example: Restoring areas of project impacted saltmarsh habitat.
- Offset
    - Ecologically compensate for remaining unavoidable residual impacts, which may be most effective outside the impact area
    - Ørsted example: Build artificial nesting structures to compensate for potential collision impacts.
- Enhance
    - Further initiatives to increase biodiversity beyond its baseline state.

- Ørsted example: Deploying artificial cod pipes at Borssele or additionally restoring areas of historically degraded saltmarsh habitat.

12. DISCUSSION

Q. What are the criteria for preparing installation?
Ans: the offshore FSPV site choosing in Ping Tung is 6 km away from coast.

Q: How heavy is the FSPV module?
Ans: 500 MW module frame is made of HDPE pipe.

Q:Where the materials from for building the FSPV?
Ans: the Rack and PV are all made in Chinese Taipei.

Q: in Australia, whether the company has to consider indigenous culture and social impacts when building offshore wind power project?
Ans: Fore sure, the bidder has to get social license from Australia government.

13. CONCLUSIONS

The APEC Workshop on Multifunctional Ocean Space Usage, focusing on the combination of floating PV installations with offshore wind, marked a significant step towards promoting sustainable energy growth and enhancing energy security within the APEC region. Through discussions and presentations, key issues such as legislative recommendations, renewable energy development goals, and utilization of ocean spaces were addressed, highlighting the potential for innovative solutions to combat climate change and advance clean energy technologies. The Workshop underscored the importance of collaboration, research exchange, and policy development to drive the transition towards a low-carbon economy and achieve the renewable energy targets set by APEC Leaders. Moreover, insights on APEC economies renewable energy transition, including Australia; Indonesia; Japan; USA; the Philippines; and European Union, provided valuable perspectives on the challenges and opportunities in achieving a resilient and sustainable energy landscape.

Chapter 7.
Conclusions

The European Union's legal framework for combined offshore renewable energy projects has emerged as a pioneering model that could serve as a valuable reference for APEC economies. The combination of multiple regulatory frameworks, coupled with the recent urgency surrounding net-zero and energy security policies, has catalyzed the deployment of offshore marine renewable energy across Europe.

However, as APEC economies embark on developing their legal frameworks for combined offshore renewable energy, it is crucial to consider the unique legal considerations and best practices that have been established through the European experience. These lessons learned can help inform and streamline the process of creating effective and comprehensive legal structures tailored to the specific needs and contexts of APEC economies.

Globally, the push for renewable energy development has been driven by the need to address climate change and achieve sustainability goals. As land-based projects encounter zoning challenges and stakeholder conflicts, marine renewables have gained increasing popularity in Europe due to their decreasing costs and relatively fewer restrictive stakeholders. This trend highlights the importance of proactively establishing legal frameworks that facilitate the responsible and efficient utilization of offshore renewable resources.

Furthermore, the implementation of marine spatial planning across the EU since 2014 has played a pivotal role in encouraging the adoption of combined offshore renewable energy projects. By requiring stakeholder engagement, public data sharing, and the designation of marine zones for renewable energy development, member states have created an environment conducive to the exploration of compatible and synergistic uses of offshore areas. Once these zones are established, the immediate advantages of combining offshore wind, tidal, and solar energy become evident, prompting both developers and regulators to consider hybrid marine renewable energy (MRE) projects.

Successful hybrid projects that combine wind and solar have demonstrated their ability to generate more energy, reduce costs, create transmission opportunities, and appeal to a broader range of stakeholders by combining different marine energy sources. As APEC economies navigate the development of their legal frameworks for combined offshore renewable energy, these experiences and lessons learned from the European context can serve as valuable guidance, helping to shape effective and forward-looking policies that support the sustainable exploitation of marine renewable resources.

References

Caine, C. A. (2020). The Race to the Water for Offshore Renewable Energy: Assessing Cumulative and In-combination Impacts for Offshore Renewable Energy Developments. Journal of Environmental Law, 32(1), 83–109. https://doi.org/10.1093/jel/eqz031

deCastro, M., Costoya, X., Salvador, S., Carvalho, D., Gómez-Gesteira, M., Sanz-Larruga, F. J., & Gimeno, L. (2019). An overview of offshore wind energy resources in Europe under present and future climate. Annals of the New York Academy of Sciences, 1436(1), 70–97. https://doi.org/10.1111/nyas.13924

Delbeke, O., Moschner, J. D., & Driesen, J. (2023). The complementarity of offshore wind and floating photovoltaics in the Belgian North Sea, an analysis up to 2100. Renewable Energy, 218, 119253. https://doi.org/10.1016/j.renene.2023.119253

Euronews. "Floating Solar and Trash Mountains: How the Netherlands Became Europe's Solar Power Leader." Euronews Green, 8 Mar. 2023, www.euronews.com/green/2023/03/08/floating-solar-and-trash-mountains-how-the-netherlands-became-europes-solar-power-leader. Accessed 26 Apr. 2024.

European Commission. (2023). Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL amending Directive (EU) 2018/2001 on the promotion of the use of energy from renewable sources, Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency.

European Commission. (2024). EU funding for offshore renewables. https://energy.ec.europa.eu/topics/renewable-energy/financing/eu-funding-offshore-renewables_en 2

Federal Public Service Economy of Belgium. (2023, February 28). Identification of the parcels for the construction of wind farms in the Belgian North

Sea. https://economie.fgov.be/en/themes/energy/belgian-offshore-wind-energy/identification-parcels

Galparsoro, I., Menchaca, I., Garmendia, J. M., Borja, Á., Maldonado, A. D., Iglesias, G., & Bald, J. (2022). Reviewing the ecological impacts of offshore wind farms. Npj Ocean Sustainability, 1(1), 1. https://doi.org/10.1038/s44183-022-00003-5

Golroodbari, S. Z. M., Vaartjes, D. F., Meit, J. B. L., Van Hoeken, A. P., Eberveld, M., Jonker, H., & Van Sark, W. G. J. H. M. (2021). Pooling the cable: A techno-economic feasibility study of integrating offshore floating photovoltaic solar technology within an offshore wind park. Solar Energy, 219, 65–74. https://doi.org/10.1016/j.solener.2020.12.062

Hansen, T. A., Wilson, E. J., Fitts, J. P., Jansen, M., Beiter, P., Steffen, B., Xu, B., Guillet, J., Münster, M., & Kitzing, L. (2024). Five grand challenges of offshore wind financing in the United States. Energy Research & Social Science, 107, 103329. https://doi.org/10.1016/j.erss.2023.103329

Hooper, T., Armstrong, A., & Vlaswinkel, B. (2021). Environmental impacts and benefits of marine floating solar. Solar Energy, 219, 11–14. https://doi.org/10.1016/j.solener.2020.10.010

Jay, S. (2010). Planners to the rescue: Spatial planning facilitating the development of offshore wind energy. Marine Pollution Bulletin, 60(4), 493–499. https://doi.org/10.1016/j.marpolbul.2009.11.010

Kumar, V.; Shrivastava, R.L.; Untawale, S.P. Solar Energy: Review of Potential Green & Clean Energy for Coastal and Offshore Applications. Aquat. Procedia 2015, 4, 473–480.

Legorburu, I., Johnson, K. R., & Kerr, S. A. (2018). Multi-use maritime platforms - North Sea oil and offshore wind: Opportunity and risk. Ocean & Coastal Management, 160, 75–85. https://doi.org/10.1016/j.ocecoaman.2018.03.044

López, M., Rodríguez, N., & Iglesias, G. (2020). Combined Floating Offshore Wind and Solar PV. Journal of Marine Science and Engineering, 8(8), 576. https://doi.org/10.3390/jmse8080576

McAteer, B., Fullbrook, L., Liu, W.-H., Reed, J., Rivers, N., Vaidianu, N., Westholm, A., Toonen, H., Van Tatenhove, J., Clarke, J., Ansong, J. O., Trouillet, B., Santos, C. F., Eger, S., Ten Brink, T., Wade, E., & Flannery, W. (2022). Marine Spatial Planning in Regional Ocean Areas: Trends and Lessons Learned. Ocean Yearbook Online, 36(1), 346–380. https://doi.org/10.1163/22116001-03601013

Water Plan 2016-2021. The European Maritime Spatial Planning Platform, 15 Apr. 2024.

North Sea Programme 2022-2027. The European Maritime Spatial Planning Platform, 30 Mar. 2024. https://www.noordzeeloket.nl/en/policy/north-sea-programme-2022-2027/. Accessed 26 Apr. 2024)

O'Hagan, A. M. (2020). 2020 State of the Science Report, Chapter 11: Marine Spatial Planning and Marine Renewable Energy (PNNL--29976CHPT11, 1633204; p. PNNL--29976CHPT11, 1633204). https://doi.org/10.2172/1633204

Ofgem, "Consultation on the Regulatory Framework including Market Arrangements for Offshore Hybrid Assets, Multi-Purpose Interconnectors and Non-Standard Interconnectors," June 2023. [Online]. Available: https://www.ofgem.gov.uk/publications/consultation-regulatory-framework-including-market-arrangements-offshore-hybrid-assets-multi-purpose-interconnectors-and-non-standard-interconnectors. [Accessed: 27-Apr-2024]

Pedersen, P. T. (2015). Marine Structures: Future Trends and the Role of Universities. Engineering, 1(1), 131–138. https://doi.org/10.15302/J-ENG-2015004

Power Technology. (2024, March 30). Elia gains environmental approval as first artificial energy island. https://www.power-technology.com/news/elia-environmental-princess-elisabeth-island/ 3

Pryor, S. C., Barthelmie, R. J., & Shepherd, T. J. (2021). Wind power production from very large offshore wind farms. Joule, 5(10), 2663–2686. https://doi.org/10.1016/j.joule.2021.09.002

Putuhena, H., White, D., Gourvenec, S., & Sturt, F. (2023). Finding space for offshore wind to support net zero: A methodology to assess spatial constraints and future scenarios, illustrated by a UK case study. Renewable and Sustainable Energy Reviews, 182, 113358. https://doi.org/10.1016/j.rser.2023.113358

Rajagopalan, S., & Landrigan, P. J. (2023). The Inflation Reduction Act – implications for climate change, air pollution, and health. The Lancet Regional Health - Americas, 23, 100522. https://doi.org/10.1016/j.lana.2023.100522

Schneider, Lisa, Sonia Heye, and Tineke Troost. Impact of Offshore Floating Solar on the Marine Environment. Deltares, 25 Oct. 2023. https://publications.deltares.nl/11208338_000_0008.pdf. Accessed 26 Apr. 2024.

Spijkerboer, R. C., Zuidema, C., Busscher, T., & Arts, J. (2020). The performance of marine spatial planning in coordinating offshore wind energy with other sea-uses: The case of the Dutch North Sea. Marine Policy, 115, 103860. https://doi.org/10.1016/j.marpol.2020.103860

Van Den Burg, S. W. K., Schupp, M. F., Depellegrin, D., Barbanti, A., & Kerr, S. (2020). Development of multi-use platforms at sea: Barriers to realising Blue Growth. Ocean Engineering, 217, 107983. https://doi.org/10.1016/j.oceaneng.2020.107983

Van Der Zant, H. F., Pillet, A.-C., Schaap, A., Stark, S. J., De Weijer, T. A., Cahyaningwidi, A. A., & Lehner, B. A. E. (2024). The energy park of the future: Modelling the combination of wave-, wind- and solar energy in offshore multi-source parks. Heliyon, 10(5), e26788. https://doi.org/10.1016/j.heliyon.2024.e26788

Vlaswinkel, B., Roos, P., & Nelissen, M. (2023). Environmental Observations at the First Offshore Solar Farm in the North Sea. Sustainability, 15(8), 6533. https://doi.org/10.3390/su15086533

Wolniak, R., & Skotnicka-Zasadzień, B. (2023). Development of Wind Energy in EU Countries as an Alternative Resource to Fossil Fuels in the Years 2016–2022. Resources, 12(8), 96. https://doi.org/10.3390/resources12080096

Xylia, M., Passos, M. V., Piseddu, T., & Barquet, K. (2023). Exploring multi-use platforms: A literature review of marine, multifunctional, modular, and mobile applications (M4s). Heliyon, 9(6), e16372. https://doi.org/10.1016/j.heliyon.2023.e16372

Appendix A
WORKSHOP PHOTOS

Dr. Liao Opening Remark

Miss Mei-Lin Kuo presentation

Discussion Session

Dr. Dwi Presentation

Dr. Keng-Tung Wu Presentation

Ms. Maya KIMA presentation

Dr. Su Presentation

Q & A section

Professor Yabar Mostacero Helmut Friedrich presentation

Dr. Chen Presentation

Mr. Nate Maynard Presentatioin

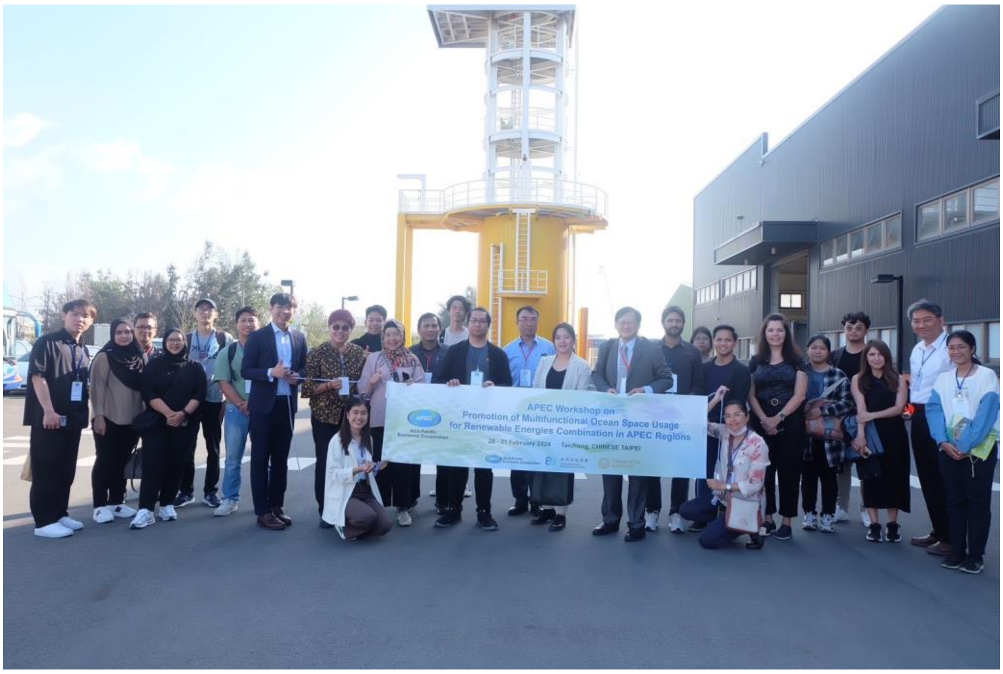
Participants discussion

Workshop banner

Registration and check in

Group photo

Group photo of speakers



Site visit

Group Photo in Taichung port

Site visit

Site visit

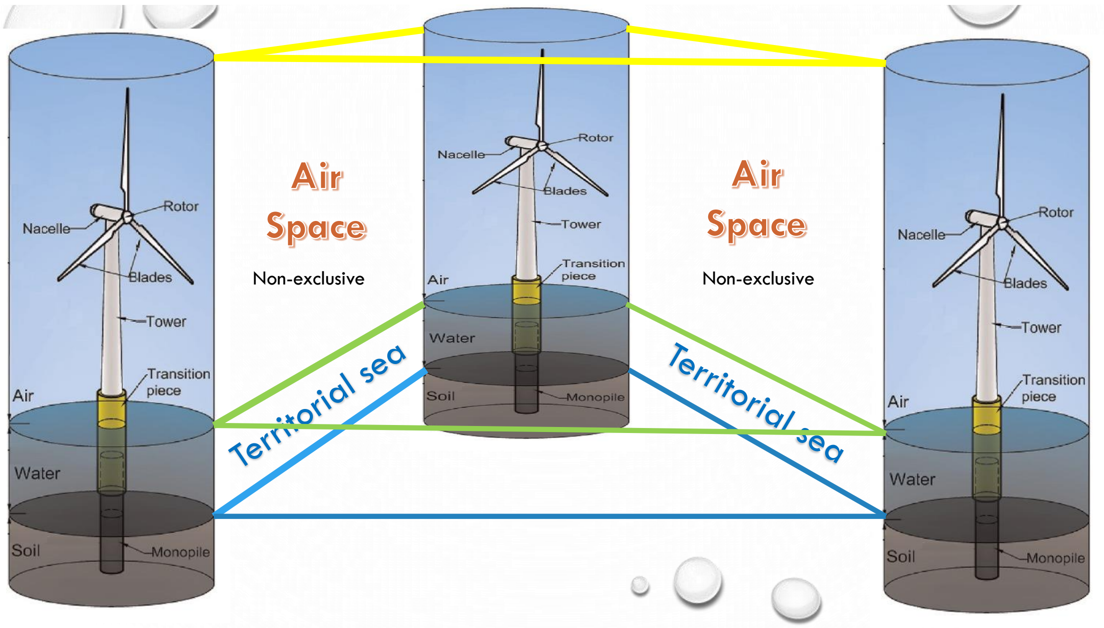
Appendix B

GUIDE BOOK

Introduction

The spatial domain of offshore wind farms encompasses three distinct components: the surface water at sea level, the atmospheric space above, and the water body above the seabed and its sediment. This research primarily investigates the nature of the rights conferred upon offshore wind power developers once they have secured construction and operation permissions for offshore wind farms. Specifically, it seeks to determine whether these rights grant exclusive use of the wind farm space or if they are non-exclusive in nature, allowing for potential shared utilization of the area.

The current legal framework delineates distinct regulatory regimes for different aspects of offshore wind farm areas. Activities at sea level are subject to fishery laws and shipping traffic management regulations. The airspace above sea level falls under the purview of civil aviation laws or aircraft control regulations. The water column extending from the surface to the seabed is governed by the laws pertaining to the territorial sea, contiguous zone, and exclusive economic zone of the coastal state. This multifaceted legal landscape, involving various applicable laws and competent authorities, may result in diverse interpretations and management approaches for offshore wind farms, contingent upon the specific matters under each authority's jurisdiction.



If, upon winning the offshore wind farm tender, the developer is limited to utilizing only the cylindrical space (figure above) encompassed by the rotational sweep of the wind turbine blades - extending vertically from the blade tips to the seabed - they would be precluded from exploiting the intervening spaces between the turbines. This restriction would significantly constrain the developer's ability to maximize the use of the entire wind farm area. If the manufacturer securing the offshore wind farm development bid is granted exclusive rights to utilize the wind farm space, the developer's capabilities extend beyond merely constructing wind turbines and their foundation piles within the designated area. They could also leverage the sea space between turbine bases to install additional wind power generation facilities, floating solar photovoltaic systems, or other types of power generation equipment. This hybrid or multiple approach would enable the expansion of power generation capacity and potential revenue streams without the necessity of obtaining further permits, thereby reducing administrative costs and streamlining the development process.

Advantages of Multiple Usage on Offshore Renewable Energy Farms

Research on hybrid energy generation reveals significant benefits in combining offshore wind and solar farms. A study found that such hybrid systems can produce seven times more energy than standalone offshore wind farms, with a 68% reduction in power output variability. This increased reliability leads to improved energy utilization.[17] Research also discovered that offshore solar panels can have 13% higher capacity than land-based systems due to water cooling effects[18]. However, they also noted diminishing returns when integrating solar panels within wind parks, due to capacity factor and cost considerations.

Hybrid projects combining offshore wind generation with transmission capabilities offer several advantages in the European context. These include creating dual-market linkages for excess energy, reducing capital expenditure by eliminating the

---

[17] López, M., Rodríguez, N., & Iglesias, G. (2020). Combined Floating Offshore Wind and Solar PV. Journal of Marine Science and Engineering, 8(8), 576. https://doi.org/10.3390/jmse8080576

[18] Golroodbari, S. Z. M., Vaartjes, D. F., Meit, J. B. L., Van Hoeken, A. P., Eberveld, M., Jonker, H., & Van Sark, W. G. J. H. M. (2021). Pooling the cable: A techno-economic feasibility study of integrating offshore floating photovoltaic solar technology within an offshore wind park. Solar Energy, 219, 65 – 74. https://doi.org/10.1016/j.solener.2020.12.062

need for separate infrastructure, streamlining integration processes, and smoothing supply and demand fluctuations (Orsted, 2024). Cost analysis reveals that wind turbines typically account for only 30% of total project costs, with significant expenses coming from maintenance, planning, and site development[19]. This suggests that integrating solar projects into existing offshore wind infrastructure could leverage existing investments and reduce overall costs.

The combination of solar and wind aligns well with economy's renewable energy targets and existing offshore wind maintenance requirements. Installing solar panels beneath wind turbines is considered low-risk, provided the technology continues to decrease in cost and improve in reliability. While few studies quantify the costs of these hybrid projects, initial research and modeling from developers are encouraging. The potential for avoiding or integrating costs related to grid connection, site planning, and maintenance for floating solar projects within existing offshore wind infrastructure could provide developers with more energy output for the same planning and development efforts.

In conclusion, hybrid offshore wind and solar projects show promise in increasing energy production, improving reliability, and potentially reducing overall costs through shared infrastructure and maintenance.

---

[19] Pryor, S. C., Barthelmie, R. J., & Shepherd, T. J. (2021). Wind power production from very large offshore wind farms. Joule, 5(10), 2663 – 2686. https://doi.org/10.1016/j.joule.2021.09.002

Current Regulations on Marine Spatial Management

EU

The EU has multiple intersecting policies that come together to provide both regulatory frameworks and incentives for hybrid marine energy. Three main policies provide both the legal framework and incentive structure for a wide range of offshore hybrid energy systems: the renewable Energy Directive, the Marine Strategy Framework, and the Spatial Planning Directive.

The Marine Strategy Framework Directive (2008/56/EC) [20] establishes a framework for the protection of the marine environment, including the implementation of environmental policy for the marine waters of the EU. It requires EU member states to adopt measures to protect the marine environment and ensure that human activities do not negatively impact it. This includes the development of CMRE projects, which must be undertaken in a way that is compatible with the protection of the marine environment. Few studies have looked at the marine biodiversity or ecological impacts of CMRE, yet preliminary studies looking at

[20] *OJ L 164, 25.6.2008, p. 19–40* . Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive) (Text with EEA relevance). https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008L0056

marine solar show light impacts relative to other developments or energy sources.[21]

In November 2020, the European Commission unveiled a comprehensive "Offshore Renewable Energy Strategy." This strategic initiative emphasizes the expansion of offshore renewable energy capacity, with a particular focus on wind power and ocean energy, encompassing all forms of energy derived from marine environments. To ensure member states' consideration of maritime space for renewable energy implementation, the Commission mandated the submission of economy's maritime spatial plans by 31 March 2021. In accordance with Directive 2001/42/EC, these plans were required to incorporate a strategic environmental assessment and additional evaluations pertaining to marine conservation within and surrounding the relevant waters. By the conclusion of 2021, only six member states—Belgium, Denmark, Finland, the Netherlands, Latvia, and Portugal—had responded to this directive and submitted their respective maritime spatial plans, demonstrating varying levels of engagement with the strategy across the European Union.

The 2014 Maritime Spatial Planning Directive (Directive 2014/89/EU) provides a framework for the formulation of maritime spatial plans. The Directive's objective, facilitated by its framework, is to encourage EU member states to assess maritime

[21] Hooper, T., Armstrong, A., & Vlaswinkel, B. (2021). Environmental impacts and benefits of marine floating solar. Solar Energy, 219, 11 – 14. https://doi.org/10.1016/j.solener.2020.10.010

space as a potential resource for fostering sustainable development. It establishes minimum requirements for these plans, including the analysis of land-sea interactions, the adoption of an ecosystem-based approach, the integration of coastal management principles, stakeholder participation, data utilization, and cooperation among member states and with third economies. Furthermore, the Directive outlines various potential activities and uses for maritime space, encompassing aquaculture, fishing, energy production, tourism, and scientific research.

Belgium

The Belgium government conceptualizes maritime space as a public resource that can be delineated into four distinct dimensions: the seabed and its underlying strata, the water column, the water surface, and the airspace above the sea. This multidimensional approach to marine spatial management reflects a comprehensive understanding of the maritime environment and its potential uses.

Belgium's consideration of introducing and developing a marine spatial plan predated the European Union Commission's actions in 2014. In March 2014, a Royal Decree was issued, establishing the first Belgian marine spatial plan. This decree designated a specific zone within the Belgian part of the North Sea (BPNS) for the development and implementation of renewable energy projects. The allocated area is situated in the eastern section of the BPNS, immediately adjacent to the Dutch territorial waters in the North Sea.

The amended "Law for the Protection of the Marine Environment and for the Organization of Marine Spatial Planning in the Sea Areas under the Jurisdiction of Belgium" was enacted in 2012 with the objective of safeguarding the natural environment, biodiversity, and overall marine ecosystem within Belgian waters. This legislation includes specific chapters addressing marine protected areas, species protection, the prevention and reduction of environmental pollution, environmental impact assessment (EIA) procedures, authorization processes, emergency measures for marine protection, marine spatial planning, and penalties for violations. The primary objectives of the marine spatial plan are to coordinate decisions that impact the sea area and to ensure the inclusive consideration of all stakeholders in the planning process. On the federal level, the Minister for the North Sea coordinates the development of the marine spatial plan. The Marine Environment Service handles the planning and implementation of the marine spatial plan.

Article 5 of this Law mandates that all economies adhere to the principles of prevention, precaution, sustainable management, polluter pays, and recovery when designing a marine spatial plan. Article 5a elucidates the structural components, procedural aspects, and temporal duration of the marine spatial plan. The governmental procedure for developing the marine spatial plan encompasses a multifaceted approach, including a planning process, public consultation, strategic ecological impact assessment, and provisions for potential amendments. The structural framework of the marine spatial plan is required to incorporate a comprehensive spatial assessment of the Belgian maritime domain, a long-term strategic vision for its utilization, and clearly delineated economic, social, environmental, and safety objectives. Furthermore, the structure must delineate the measures and instruments that facilitate the effective implementation of the marine spatial plan. The legislation mandates a sexennial review of the marine spatial plan by the government.

The second Belgian Marine Spatial Plan (Marien Ruimtelijk Plan) entered into force in March 2020 and also accept the multiple uses of marine space. Following a comprehensive environmental impact assessment in the realm of renewable energies, it has been proposed that wind power plants could potentially be integrated with electricity generation from wave or tidal sources.

Permits and Related Regulations

Belgium

Renewable energy operators must obtain four primary permits to develop and operate offshore renewable energy projects in Belgium. Specifically, these permits are the domain concession, the marine protection permit (also called as environmental permit), the cable laying permit and Natura 2000 admission. Upon receiving all necessary permits, the Federal Minister of Energy mandates that offshore wind farm operations must commence within three years. The 2019 amendment to the Electricity Market Organization Law consolidated all permit application processes for competitive tenders pertaining to offshore renewable energy projects. Consequently, the project operator who submits the winning bid is granted all previously mentioned permit rights essential for the construction and operation of offshore renewable energy installations. This streamlined approach integrates the various permitting requirements into a single, comprehensive process aligned with the competitive tender procedure.

(1) domain concession permit

According to Article 6 of the Belgian Federal Electricity Act of April 29, 1999, offshore projects require the status of a domain concession (Domeinconcessies) for the construction and operation of water, tidal, or wind power plants within the Exclusive Economic Zone (EEZ). The domain concession agreement grants the applicant the right to temporarily utilize a specific part of a public area for private purposes, thereby restricting other parties from using this area. Consequently, the government entrusts a portion of its property usage rights to the project operator. Therefore, the operator (domain concession permit holder) has the exclusive right to us the granted ocean space.

The responsibility for issuing the domain concession permit lies with the Minister of Energy. Applications for the permit must be submitted to the General Energy Directorate of the Federal Public Service for Economy, Small and Mediums-sized Enterprises, Self-Employed, and Energy. Upon obtaining the domain concession status, the project operator is authorized to use the designated area for the construction and operation of offshore renewable energy installations.

(2) Marine Environment Permit

The environmental permit (Milieuvergunning) grants the holder the right to construct and operate the installation. The legal foundation of this permit is primarily established by the Marine Protection Act. The Royal Decrees on MEP of 1999 also concerning the permit procedure and authorization for maritime activities, specifically those related to environmental impact assessments for the protection of the marine environment (Royal Decree on MEP)[22], are also relevant legal instruments that must be considered when applying for an environmental permit.

In addition to the Marine Protection Act, the Royal Decrees pertaining to the permit procedure and authorization for maritime activities, as well as the regulations on environmental impact assessments for the protection of the marine environment (Royal Decree on MEP), must be taken into consideration when applying for an environmental permit. The central authorized agency responsible for this process is the Scientific Service Management Unit of the North Sea Mathematical Models (MUMM). Project operators are required to submit an environmental impact study along with a permit application to MUMM. Subsequently, MUMM initiates a

[22] Koninklijk besluit houdende de regels betreffende de milieu-effectenbeoordeling in toepassing van de wet van 20 januari 1999 ter bescherming van het mariene-milieu in de zeegebieden onder de rechtsbevoegdheid van België.

public consultation process, followed by conducting an Environmental Impact Assessment (EIA).

The final decision regarding the issuance of the environmental permit rests with the Minister of the North Sea, who bases this determination on the results of the environmental impact study, the EIA, and the public inquiry. The process of issuing the environmental permit typically spans six to eight months from the date of submission. Once granted, the environmental permit, which encompasses both construction and operating authorizations, remains valid for a period of 20 years.

(3) Cable Laying Permit

Project operators also must obtain a cable laying permit (Kabellegvergunningen) from the Federal Public Service for Economic Affairs. According to the Royal Decree of 2002, project operators are required to lay new cables in close proximity to existing cable channels to minimize the impact on the seabed. Article 4 of the Federal Act of 1969 mandates that the submitted permit application must include detailed information on the financial and technical capacity of both the project and the operator. Furthermore, Article 4 stipulates that the permit must be issued within 155 days of receiving the application.

(4) Natura 2000 admission

Project operators are required to apply for a Natura 2000 admission only when implementing renewable energy projects in ocean spaces. The admission application must be submitted to the Scientific Service Management Unit of the North Sea Mathematical Models (MUMM). Admission is granted solely if the project does not pose a threat to the natural habitats of unique species. The Minister of the Protection of the North Sea is responsible for issuing the Natura 2000 admission.

Short Summary

It is important to note that the development and management of offshore renewable energy in Belgium are regulated through a system of permits. The offshore renewable energy developer who secures these permits is granted exclusive rights to utilize the authorized sea area as specified by the permits.

Germany

The Federal Regional Planning Act of 2007 (Raumordnungsgesetz, hereafter referred to as ROG) provides the legal framework for the design, management, and regulation of Maritime Spatial Planning (Maritime Raumplanung). In 2017, it was amended to incorporate the EU directive on maritime spatial planning. The Federal Ministry of the Interior, Building, and Community is responsible for creating a marine spatial plan for the German Exclusive Economic Zone (EEZ). The Ministry is supported by the German Federal Maritime and Hydrographic Agency (Bundesamt für Seeschifffahrt und Hydrographie, BSH) in both the planning and execution of the marine spatial plan. These plans should encompass considerations for ensuring the safety and efficiency of maritime navigation, promoting the economic and scientific utilization of marine areas, and incorporating measures for the protection and enhancement of the marine environment. The spatial plans shall be revised in every 10 years.[23]

In Germany, the responsibilities for coastal zone management and the Exclusive Economic Zone (EEZ) are distinctly divided. The coastal federal provinces hold jurisdiction over the territorial sea area, whereas the federal government oversees and administers the German EEZ in both the Baltic and North Seas. The Federal Maritime and Hydrographic Agency has already published the second draft of the plan in 2021.[24] The offshore wind energy section of the federal marine spatial plan stipulates that offshore wind energy zones are designated for multiple uses. These zones may also accommodate fishery research, passive fishing within the safety perimeter of wind farms, and the operation of military vehicles. However, such activities should not be conducted in close proximity to the outermost turbines. Additionally, these activities must not interfere with the construction, maintenance, or operation of the wind farms. It means the offshore renewable energy operator shall have exclusive right on zone usage.

In order to create offshore wind energy sites, the Germany Federal government shall encompass S*ite Development Plan (Flächenentwicklungsplan*, hereafter

[23] ROG, 2008/revised on the 3rd of December 2020, Sect. 7, Para. 8.
[24] Federal Ministry of the Interior, Building and Community & Federal Maritime and Hydrographic Agency, 2021

called *FEP)* to establish testing of suitable sites, and tangible approval for wind farms. The Federal Maritime and Hydrographic Agency will conduct the preliminary site investigation in case of projects in the EEZ and the competent agency of the federal provinces in case of projects in zones of the territorial sea. Finally, the Federal Network Agency will carry out the bidding processes for the offshore renewable energy farm.

Pursuant to Section 45, Paragraph 1 of the WindSeeG (2017), the construction, operation, and significant modifications of a wind farm necessitate planning approval. Project operators are eligible to apply for this planning approval only after securing an award through the bidding process for their project proposal. The tender award grants the bidder the exclusive right to initiate the planning approval procedure. This planning approval authorizes the project operators to construct and operate an offshore wind farm within the designated sea area. The planning approval contains all relevant permissions to use the approved sea area.[25]

Short Summary

The German government does not adopt permit system to develop and manage their offshore renewable energy sites. They use the Plan Review system to create offshore wind farms and contain all required permits. The winner of the Plan bidder owns exclusive right to use the site and other activities shall not disturb its

[25] WindSeeG, 2017/revised on the 21st of December 2020, Sect. 24, Para. 1.

operation.

The Netherland

The offshore spatial management and planning was integrated into the Water Act (Waterwet) of 2009[26]. According to Article 4.8 of the Water Act (2009), the Water Plan has to be revised every six years. The Ministries of Infrastructure and Water Management and Agriculture, Nature and Food Quality are responsible for preparing the Water Plan. The major topics of the Water Plan are energy transition, multiple uses of space, linking sea and land, and accessibility and nature conservation[27].

The offshore renewable energy parcels, assigned and designed by the Water Plan, are designated water areas allocated to subsidy recipients during the subsidy tender process. Ultimately, the bidder presenting the most suitable proposal for a parcel is granted the exclusive right to construct a wind power plant in the specified area. Therefore, the tender owner has exclusive right to use the granted parcel in the offshore area. Within the Water Plan, the Ministry of Infrastructure and Water Management is responsible for conducting an EIA. In the end, the bidder with the most suitable bid for a parcel receives the exclusive right to construct a wind power plant in that designated area.

[26] Waterwet, 2009/revised on the 1st of July 2021.
[27] Ministry of Infrastructure and the Environment & Ministry of Economic Affairs, 2015, p.45.

The Dutch Offshore Wind Energy Act (Wet windenergie op zee) of 2020 [28]assigned the Ministry of Economic Affairs and Climate Policy to regulate and manage the offshore wind farm area. It also states the offshore wind farm owner has exclusive right on the usage of the specific ocean area. The Netherlands introduced a new subsidy concept through a tender process to legally enable multiple uses of offshore wind farm areas. Before the tender, wind farm operators and co-users can form consortia and apply for an umbrella permit[29]. Post-tender, the parties must coordinate their projects. The Area Passport Guide outlines the most suitable activities for specific areas. The final step is to submit a permit application for the multiple uses of the wind farm.

The Multiple Use Assessment Framework serves as a governmental instrument in the Netherlands for evaluating the permissibility of specific activities within offshore wind farms under multiple-use operations. This framework is designed to facilitate permit issuers in their assessment of applications and to provide applicants with a comprehensive understanding of the approval process and requisite documentation. The scope of the Assessment Framework encompasses all activities necessitating a permit for multiple uses within offshore wind farms. Upon approval, the permit confers upon project operators the legal authority to execute activities that fall within the purview of the multiple-use framework in these designated offshore areas. According to Article 15, Paragraph 2 of the Offshore

[28] Wet windenergie op zee, 2015/revised on the 1st of January 2020.

[29] Ministry of Infrastructure and Water Management et al., 2021, pp.110 – 111.

Wind Energy Act, the maximum lifespan of an offshore wind farm is 30 years.[30]

Summary

The Netherlands has adopted the Water Plan and the Multiple Use Assessment Framework to facilitate the application process for permits related to additional activities in offshore wind farm areas. Offshore wind farm owners can apply for umbrella permits to utilize these areas. This system of plan review and umbrella permits is analogous to the system employed in Germany.

Chinese Taipei

According to the Directives formulate of offshore wind power planning site application of 2015, it defines the wind farm area is equal to the sea area and the applicant shall sign leasing contract with the government. The sea area leasing contract grants the contractor to get exclusive usage permits on the offshore wind farm area. Based on the Article 6 & Article 6.2 of the Non-Urban Land Use Control Rules, the legal nature of the sear area usage right belongs to the Right in Rem of real estate property, which is an exclusive usage right on the assigned sea area. The Directives formulate for offshore wind power zone development planning application of 2021 provides application framework for the offshore wind farm.

---

30 Ministry of Infrastructure and Water Management et al., 2021, p.118.

The offshore wind farm management policies and mechanisms adopted by Chinese Taipei include Plan Review and umbrella permit grants. These policies grant the offshore wind farm project owner the exclusive right to utilize the designated ocean area.

Conclusions

Building on the experiences of the EU and European economies, most economies have adopted the plan review and umbrella permit system to grant exclusive usage rights to bid owners within marine spatial management. The following table illustrates the various management measures employed by EU member states and APEC economic members concerning the marine spatial usage for offshore wind farm projects. The comparison indicates that the plan review and umbrella permit system has been adopted by the majority of government agencies.

Comparison on marine spatial Management measure

	Belgium	Germany	Netherland	Chinese Taipei
Laws	V	V	V	X
Maritime spatial plan (within territorial sea)	V	V	V	X

Space usage right (Right to use the sea area)	Lease Agreement, Exclusive right 1. Domain permit 2. concession permit	Non-exclusive	Exclusive/ domain concession	Exclusive permit; Lease agreement
Permits	1.MEIA permits 2. Cable permits	X, planning application and review	Umbrella permits	Umbrella permits
Multiple usage of spaces	V	X	V	X

The legal nature of the exclusive usage right of marine spatial management is equivalent to the Rights in Rem of real estate property of Civil Law. The lease agreement and exclusive permits provide strong support on developing renewable energy developing in the marine spatial area. However, the fishing right under the Fisheries Act and the scientific research activities are also belonging to exclusive right. Without proper arrangement, the conflicts among exclusive usage right on specific marine area would delay the installation and construction schedule and cause huge economic lost of the offshore wind facilities constructors. The experiences of Japan and Korea, where the "Marine Utilization Impact Assessment System" or the "Special Law on the Promotion of Wind Power" were not passed, resulted in delays in offshore wind power installations because bidders were compelled to negotiate with other exclusive rights holders or fishermen. Last but not least, in this research the government shall use laws to manage the offshore wind power installations because these offshore wind power projects are big investments and have a direct connection with private property protection of economies. Based on the principle of legal supremacy, the government shall use Laws adopted by the Congress or Parliament to manage the offshore space and promote offshore renewable energy promotions.