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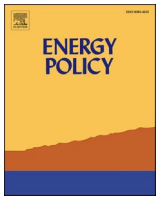

Environmental licensing for offshore wind farms: Guidelines and policy implications for new markets

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ABSTRACT

Offshore wind energy is a key driver of the global energy transition towards climate change. The regulatory framework in environmental licensing for renewable energy sources is specific for each country, however there are basic elements that can be replicated for new markets. This article aims to propose guidelines and policy implications in environmental licensing for offshore wind projects for new markets based on the state of the art and lessons learned from three mature countries and one emerging market. The research involved three phases: literature review on sustainable development and environmental licensing procedures for offshore wind farms; research cases in the United Kingdom, Germany, Denmark, and Taiwan; and the structuring of guidelines and policy implications. As a result, eight guidelines and their policy implications are proposed, among them: (i) Establishment of a national offshore wind energy production target; (ii) Mapping of marine offshore wind zones; (iii) Adoption of a "one-stop-shop" procedure; (iv) Development of a guide for environmental licensing for offshore wind farms; and others. In conclusion, the establishment of a regulatory framework in environmental licensing for offshore wind projects, based on sustainable development principles and good practices of leading markets, guides public policies of new markets to have a greater probability of sustainable development.

1. Introduction

Human activities are estimated to have caused approximately 1.0 °C of global warming above pre-industrial levels (IPCC - Intergovernmental Panel on Climate Change et al., 2018). Annual energy-related CO_2 emissions need to fall more than 70% from now until 2050 to move the world towards meeting the goals of the Paris Agreement. Such a transformation is possible with the rapid replacement of conventional fossil fuel generation and uses in the direction of cleaner renewable forms of energy (IRENA - The International Renewable Energy Agency, 2020).

Through its high CO_2 abatement potential, wind energy can help stopping global warming. It is the most sustainable and economical source of energy. Also, offshore wind will be a key driver of the global energy transition over the next decades (GWEC - Global Wind Energy Council, 2020a, 2020b). Installing more than 93 GW of wind power in 2020, a 53% growth compared to 2019, the new installations bring global cumulative wind power capacity up to 743 GW (GWEC - Global Wind Energy Council, 2021).

Considering the global offshore wind industry, China leads the world in new annual installations with over 3 GW. The UK remains in the top spot globally in terms of cumulative offshore wind capacity, while China has become the world's second largest market (GWEC - Global Wind Energy Council, 2021). Furthermore, there is technical potential for offshore wind in eight emerging markets: Brazil, India, Morocco, Philippines, South Africa, Sri Lanka, Turkey, Vietnam, with Taiwan as a leading market for offshore wind (ESMAP - Energy Sector Management Assistance Program, 2019). The successful adoption of Offshore Wind Power (OWP) by European countries has been traced to the unique progressive policies adopted by those countries to harness this sector (Mani and Dhingra, 2013; González et al., 2020).

On the other hand, as an emerging sector, it still has gaps to be filled

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Abbreviations

AfL	Agreement for Lease
BfN	Federal Agency for Nature Conservation
BMWi	Federal Ministry for Economic Affairs and Energy
BNatSchG	German Federal Act on Environmental Conservation
BNetzA	Federal Network Agency
BoE	The Bureau of Energy
BSH	Federal Maritime and Hydrographic Agency of Germany
CES	Crown Estate Scotland
CPS	Contracted Position Statement
DCO	Development Consent Order
DEA	Danish Energy Agency
DIP	Demonstration Incentive Program
DMA	Danish Maritime Authority
DNA	Danish Nature Agency
DTU	Denmark Technical University
DWEA	Danish Working Environment Authority
EEG	German Renewable Energy Sources Act
EEZ	Economic Exclusive Zone
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EL	Electricity License
EPA	The Danish Environmental Protection Agency
EPA	Taiwanese Environmental Protection Administration
EP	Establishment Permit
FEP 2019	Site Development Plan 2019
FiT	Feed-in-Tariff
GHG	Greenhouse Gas
GW	Gigawatts
HRA	Habitats Regulations Assessment
IDB	Industrial Development Bureau
ITT	Invitation to Tender
IPCC	Intergovernmental Panel on Climate Change
KSG	Climate Protection Act
MMO	Marine Management Organization
MoEA	The Ministry of Economic Affairs
MS-LOT	Marine Scotland Licensing Operations Team
MSP	Maritime Spatial Planning
MW	Megawatts
NSIPs	Nationally Significant Infrastructure Projects
OEMs	Original Equipment Manufacturers
Ofgem	The Office of Gas and Electricity Markets
OWP	Offshore Wind Power
PINS	The Planning Inspectorate for England and Wales
PPA	Power Purchase Agreement
PQQ	Pre-qualification Questionnaire
RE Act	Danish Renewable Energy Promotion Act
ROG	German Federal Regional Planning Act
SCDS	Supply Chain Development Statement
SD	Sustainable Development
SDG	Sustainable Development Goals
SDP	Site Development Plan
SEA	Strategic Environmental Assessment
SIN	National Interconnected System
SeeAnlV	Federal Marine Installations Ordinance
SMP	Sectoral Marine Plan for Offshore Wind
StUK4	Standard Investigation of the Impacts of Offshore Wind Turbines on the Marine Environment
SVIA	Seascape and Visual Impact Assessment
T-REC	Taiwan Renewable Energy Certificate
TCE	The Crown Estate
TPC	Taiwan Power Company
TSO	Transmission System Operator
UVPG	Environmental Impact Assessment Act
WindSeeG	Offshore Wind Energy Act
WSV	Federal Waterways and Shipping Administration
ZAP	Zonal Application Planning
ZD	Zonal Development
ZOP	Zones of Potentials

for its effective implementation. Studies in the scientific literature have identified that the two main causes of delay in authorizing offshore wind farms are Environmental Assessments (EA) (Gibson and Howsam, 2010; Musial and Ram, 2010; Salvador et al., 2018; Broadbent and Nixon, 2019; Allan et al., 2020; Gonyo et al., 2021).

Secondly, consenting is still generally regarded as a non-technological barrier for progress in the renewable marine energy industry, caused by the complexity of the processes and the lack of dedicated legal frameworks (Simas et al., 2015; Welisch and Poudineh, 2020). Thus, Wright et al. (2016) agree that consenting processes are a major barrier to ocean energy while the legal and regulatory frameworks surrounding environmental impacts are clearly a priority area. According to Salvador et al. (2018) and Pezy et al. (2020), environmental, technical, economic, social, and legal factors have all contributed to the failure to bring wind energy projects to fruition in any meaningful way.

Considering this, the research question emerged: "what are the environmental licensing regulatory guidelines and good practices that new markets should consider for the development of offshore wind projects?".

This study aims to propose guidelines and policy implications in environmental licensing for the development of offshore wind power in new markets based on the state of the art and lessons learned from mature countries, such as the United Kingdom, Germany, Denmark, and Taiwan.

The paper is structured into five sections: section 2 presents the literature review on sustainable development and environmental licensing procedures for offshore wind farms. Section 3 comprehends the research method. Section 4 provides description of the research cases. Section 5 describes the cross-case analysis, the guidelines and policy implications in environmental licensing for the development of offshore wind power in new markets. Section 6 presents the conclusions, and recommendations for future studies.

2. Literature review

This literature review is divided into sustainable development concepts and environmental licensing information of offshore wind projects. Its focus is to present background information regarding the current state of discussion.

Sustainable development (SD), although a widely used idea, has many different meanings and therefore, issues regarding the concept's definition, history, pillars, and principles. Besides this, its implications for human development remain unclear (Hopwood et al., 2005; Mensah, 2019; Shi et al., 2019). The most known definition of SD is the one proposed by the Brundtland report which states that it meets the needs of the present without compromising the ability of future generations to meet their own needs (United Nations, 1987).

In its evolution, the concept of SD has been popularized in three dimensions of sustainability: ecological, social, and economic pillar of sustainability. The relationship between these pillars is set in the equilibrium sustainability framework called Triple bottom line, which is well known and suitably adapted in different fields of human activities (Elkington, 1994; Klarin, 2018). In other words, Sustainability is a feature, that must be part of the development and be an integral part of

those three dimensions (Rudohradská, 2020). There are two main approaches of SD: strong sustainability and weak sustainability. The main difference between these approaches concerns the substitutability between environmental assets and man-made capital (Neumayer, 2013; Omri et al., 2015).

In 2015, 196 parties came together under the Paris Agreement in a commitment to transform their development trajectories towards climate change (Caetano et al., 2020). In the same year, 17 Sustainable Development Goals (SDG) and 169 targets were adopted by all United Nations Member States as a part of 2030 Agenda for Sustainable Development. Among the goals, it establishes an increase of the share of renewable energy in the global energy mix to ensure and facilitate the access to affordable and clean energy by 2030 (SDG 7) (United Nations, 2015).

To achieve the SDGs and the Paris Climate Agreement, governments and other stakeholders need to organize interventions, such as improved policies, public and private investments, and regulation and how to deploy them (Sachs et al., 2019). At the same time, complete a systematic and radical energy transition from fossil fuels to renewable energy and low-carbon solutions is imperative (GWEC - Global Wind Energy Council, 2021). For these purposes, renewable energy is crucial to achieve international commitments to fight climate change and offshore wind represents a key enabler of the global energy transition (De Castro et al., 2018; GWEC - Global Wind Energy Council, 2020b).

González et al. (2017), in their conceptual model, show that it is necessary to consider multidimensionality, temporal and geographical aspects of SD when attempting to install a renewable energy development; public and manager participation in a top-down and bottom-up perspective; map the positive and negative impacts; using sustainability indicators; and propose guidelines and best practices under the bias of sustainability, which will be monitored by the aforementioned indicators.

Considering this, rules are crucial to make the economic exploitation of offshore wind potential compatible with the preservation of the marine environment (Guimarães, 2019). As can be seen, actions aiming at promoting new forms of renewable energy must be taken under the scope of the energy policy (Lièvre, 2019). Thus, the implementation of Environmental Licensing in OWP represents a way to achieve a SD.

Offshore wind projects require appropriate consent from the governing authorities responsible for the areas potentially impacted by the projects (Broadbent and Nixon, 2019). At an international level, there are several restrictions established under regulation of offshore wind farms by Marine Environmental Law (Guimarães, 2019). According to the United Nations Convention on the Law of the Sea of 1982 (UNCLOS), coastal states have full sovereignty over their internal waters and their territorial seas up to 12 nautical miles from the coast (De Castro et al., 2019).

Europe has led the way in OWP and has reached the required level of maturity, both technologically and commercially (De Castro et al., 2019). Consenting processes for ocean energy across European Union Member States show that there is a great variation in the procedures among countries. Also, there are many different authorities who have a role in the procedure (Simas et al., 2015).

On the other hand, the general trend in Europe is towards rationalization and simplification of the licensing process. The leading European countries in the development of offshore wind projects have implemented different mechanisms. One of these instruments is the adoption of a One-Stop-Shop system, in which a single body is responsible for managing the whole licensing process. It reduces the number of licensing bodies and required licenses. This adoption of an active role by governments to conduct preliminary research is an attempt to eliminate uncertainty regarding the environmental effects derived from sea-based facilities (De Castro et al., 2019). The implementation of a 'one-stop--shop' approach for marine energy consenting is perceived as a means of streamlining the consenting process (Simas et al., 2015; Vasconcelos, 2019).

The key factor in the development of wind energy projects is selecting the best locations for installation (De Castro et al., 2018). In Europe, EU member states are obliged under the Maritime Spatial Planning (MSP) Directive to develop a national maritime spatial plan, under the Directive 2014/89/EU (European Commission, 2020). In addition, the public and stakeholders should be involved in the process and neighboring countries bordering the same marine waters are obliged to cooperate in a coordinated planning approach (Vasconcelos, 2019).

Moreover, in this planning process, other EU directives are aimed at preventing the development of adverse effects on the marine environment and ensuring the protection of biodiversity arising from the installation of offshore wind farms. These are Strategic Environmental Assessment (SEA) Directive 2001/42/EC an assessment of the effects of certain plans and programs on the environment, and Environmental Impact Assessment (EIA) Directive 2014/52/EU amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment, which subjects concrete private or public projects to an environmental impact assessment and also the location of Natura 2000) areas on the basis of the provisions of the Habitats Directive 92/43/EEC; Birds Directive 2009/147/EC (De Castro et al., 2018, 2019).

Offshore wind farms have unique impacts, which are addressed through environmental and natural resource policies and rules (White & Case, 2019). Wessier (2007) details that, for wind turbines, most of the Greenhouse Gas (GHG) emissions arise at the turbine production and plant construction, which vary between 72% and 90% of cumulative emissions. For instance, offshore wind turbines require significantly higher amounts of steel and cement for construction than onshore counterpart. It is now widely recognized that the GHG emissions need to be quantified over all stages of the technology and its fuel life cycle.

While the ways in which EIAs are conducted differ by country (Maclean et al., 2014), governments in many of the key markets for offshore wind investment typically require the environmental and social impacts of a proposed offshore wind project to be assessed and mitigated. In most jurisdictions, the environmental and social impact assessment is subject to public scrutiny and comment and can also be vulnerable to legal challenges (White & Case, 2019).

Once project developers have gathered and analyzed environmental data, and engaged with the relevant stakeholders, a consent application is submitted to the relevant governing authorities who will then consider the evidence decide whether the project should receive consent to proceed or not (Broadbent and Nixon, 2019). Regarding fishing, there are use of fees, taxes, and compensatory agreements to help compensating fishermen and mitigating impacts on the sector (Vasconcelos, 2019).

3. Research method

The research can be characterized as a case study, carried out for exploration, construction, test, and refinement of theories (Yin, 2009; Voss et al., 2002). Four research cases were carried out with the aim to improve information through comparisons that served as a basis for the elaboration of the proposed guidelines and policy implications (Eisenhardt and Graebner, 2007).

The research procedure included three phases, according to Fig. 1. The first phase was the literature review on SD and environmental licensing procedures for offshore wind farms. The second was conducting the case studies in United Kingdom, Germany, Denmark, and Taiwan. In the last phase, the environmental licensing procedures adopted by the countries were analyzed, as well as a cross-case analysis to identify similar and divergent points.

When conducting case-based research, the case selection should be based on criteria that connect directly to the research question behind the proposed study (Yin, 2009; Voss et al., 2002). United Kingdom and Germany were selected for being the first and the third top spot globally in terms of cumulative offshore wind capacity (GWEC - Global Wind

Fig. 1. Research phases.

Energy Council, 2021). Denmark was selected for being pioneer country to install wind turbines out at sea and has the most experience in the world with tenders for offshore wind power (DEA - Danish Energy Authority, 2017; Nielsen and Hemmer, 2018). On the other hand, Taiwan was selected for becoming one of the offshore wind power hotspots in Asia (GWEC - Global Wind Energy Council, 2018).

Each case study included: i) A brief description of the OWP scenario; ii) The description of the environmental licensing procedure adopted by the country, from scientific articles, technical reports, decrees, resolutions and technical information from official institutions websites involved in the regulatory process; iii) creation of an interview script considering the regulatory process of the country under study; iv) face-to-face interviews with representatives of the country's institutions under study, except Taiwan; v) focus groups with experts in the area for the modeling.

The research was introduced to the representatives previously by e-mail before the interview dates and they took place between June and October 2018. There were four interviews conducted in each of the three countries, Denmark, United Kingdom, and Germany. A semi-structured questionnaire (see Appendix A) was used for the interviews regarding the issues: i) how was offshore wind power developed in the country, ii) current legal framework in the country, iii) authorities that participate in the regulation process, iv) required licenses and, v) incentives.

For the UK and Germany cases, all the interviews were conducted during the realization of the events "Global Offshore Wind 2018" in Manchester-England and "Global Wind Summit 2018" in Hamburg-Germany. For the Denmark case, two interviews were conducted at the event "Global Wind Summit 2018" and the other two in Copenhagen-Denmark (see Table 1).

For the comparison between the environmental licensing procedures of the cases, the following criteria were used: licensing entities, parameters adopted for categorizing the size of the enterprise, types of environmental licenses and permits, environmental assessment requirements and requested studies, as well as laws and normative instruments.

In the third phase, based on the results of the literature review and cross-case analysis, a set of guidelines and policy implications in environmental regulation and licensing for the development of offshore wind projects in new markets were modeled. To validate the suggested guidelines, two focus groups were conducted.

The first focus group took place in May 2019 and involved five researchers in the area of offshore wind. The second focus group took place in November 2020 and the participants were seven specialists in the area of onshore wind with two experts in environmental licensing among them.

Table 1
Participants interviewed in the cases.

Denmark	- Director of Global Cooperation of "Danish Energy Agency (DEA)" - Professor of Wind Energy Department of "Denmark Technical University (DTU)". - Head of Policy of the Association "Wind Denmark". - CEO of "MHI Vestas Offshore Wind".
Germany	- Director of Marine Spatial Planning of "Bundesamt fur Seeschiffahrt und Hydrographie (BSH)". - Executive Director of "Niedersachsen Ports". - Marine, Logistics and Lifting Manager of "Siemens Gamesa" Director of "Cuxhaven Port".
United Kingdom	- Head of Energy Development of "The Crown Estate (TCE)". - Business & Strategy Development Manager of Offshore Wind Engineering and Consultancy of "Atkins Global". - Non-executive director of "Offshore Renewable Energy Catapult" Director of Research "4C Offshore Ltd".

4. Research cases

This section describes the environmental licensing procedures of offshore wind projects regarding UK, Germany, Denmark, and Taiwan. It includes a description of the OWP scenario and the environmental licensing procedures adopted by each country. The information presented in this section served as the base of the comparative analysis between the cases. Furthermore, it supported the identification of similarities and differences among their procedures which were used in the construction of the proposed guidelines, and policy implications of this study.

4.1. United Kingdom case

The UK has the largest installed capacity in offshore wind in the world. It is expected to reach 40 GW of offshore wind installed by 2030, in order to fulfill the 2008 Climate Change Act which commits a 34% reduction in GHG emissions by 2020, and UK's new net zero by the 2050 target (CCC - Committee on Climate Change, 2019; Coxall and Hardacre, 2020; GWEC - Global Wind Energy Council, 2021).

The allocation of exploitation rights for offshore wind farms has happened in phases (Leasing Rounds 1, 2 and 3). In Round 1, considered

a learning phase, the government issued guidelines on potential offshore development and developers chose sites for Rounds 2 and 3. The process of identifying suitable areas was subjected to more detailed Strategic Environmental Assessment (SEA) of the potential impacts (WWEA - World Wind Energy Association, 2018). In 2019, TCE launched the Offshore Wind Leasing Round 4, opening installations up for at least 7 GW of new OWP (Hogan Lovells, 2020; TCE - The Crown Estate, 2021).

4.1.1. Environmental licensing process of offshore wind in UK

The consenting process for ocean energy projects in the UK varies according to the jurisdiction in question (Simas et al., 2015). Under the terms of the Energy Act of 2004, TCE manages the rights to generate electricity from wind, waves, and the tides on the continental shelf in England, Wales and Northern Ireland, in addition to the territorial seas. The management of the Scottish seabed is made by the Crown Estate Scotland (CES) (TCE - The Crown Estate, 2019b).

The main legislation for offshore wind farms in England, Scotland and Wales is the Electricity Act 1989, the Planning Act 2008, the Marine and Coastal Access Act 2009 and the Marine (Scotland) Act 2010 (White & Case, 2019). In addition, the UK is subject to international and European nature and conservation conventions and laws, the Habitats Directive (EU 92/43) and the Birds Directive (EU 2009/147) (Coxall and Hardacre, 2020).

UK has adopted an open-door regime at Round 1. Developers could choose where to site their projects and develop an EIA voluntarily or request a screening opinion on whether EIA is required for their project, which depended on its scale, location, and thus potential impacts. Also, the submission of an Environmental Impact Statement (EIS) was a key element of the process (WWEA - World Wind Energy Association, 2018).

In England and Wales, any offshore energy project between 1 and 100MW is consented by the Marine Management Organisation (MMO). Projects over 100MW are classified as a Nationally Significant Infrastructure Project (NSIP) and are processed by the Planning Inspectorate for England and Wales (PINS) (WWEA - World Wind Energy Association, 2018; White & Case, 2019). They also require a Development Consent Order (DCO) granted by the Secretary of State and a marine license from MMO (UK, 2014).

For large offshore wind projects, an EIA is required, unless the relevant authority grants an exemption. An EIA assesses all potential environmental impacts of a project during construction, operation and decommissioning, and any associated mitigation measures. Consultation bodies, members of the public and interested third parties have the right to submit representations about any potential environmental impacts, which the planning authority must consider. The developer must also undertake a Seascape and Visual Impact Assessment (SVIA) as part of the EIA process to identify a site location with the least adverse visual impacts (White & Case, 2019).

UK's Round 4 offshore wind leasing consists of five stages (Fig. 2). Throughout the Habitats Regulations Assessment (HRA) process, consultations are made with the relevant UK statutory marine planning authorities, statutory nature conservation bodies, relevant non-governmental stakeholders, and relevant authorities from neighboring member states. In the last stage, Agreement for Lease (AfL), the seabed rights are awarded following the completion of the tender process and plan level HRA approval (TCE, 2019c).

In Scotland, marine licenses are issued by the Marine Scotland Licensing Operations Team (MS-LOT) in a one-stop-shop procedure. MS-LOT also leads in the identification of potential suitable areas for commercial-scale offshore wind development and, in 2020, it prepared a Marine Sectoral Plan (MSP), which included a full Sustainability Appraisal (encompassing a SEA, a Habitats Regulations Appraisal and a Social and Economic Impact Assessment) as well as significant planning and stakeholder engagement (Scottish Government, 2020). Fig. 3 describes the ScotWind Leasing Process.

CES also requires developers to submit a Supply Chain Development Statement (SCDS), outlining the anticipated level and location of supply chain impact from their proposed project, broken down by project stage (development and consenting, construction, operation, and maintenance) and must be updated as project development progresses (CES, 2020b).

4.2. Germany case

Germany is the world's third largest offshore wind market with 7.7 GW of cumulative capacity (GWEC - Global Wind Energy Council, 2021). The base for the expansion of renewable energies was laid down in the 2000 German Renewable Energy Sources Act (EEG). Following the EEG reform in 2017, the tariff-based auction was made compulsory for offshore wind projects (BMWi - Federal Ministry for Economy and Energy, 2015; GWEC - Global Wind Energy Council, 2020a).

In 2019, the German government adopted the Climate Protection Programme 2030 which sets a national target to increase the use of renewable energy to a 65% share of gross electricity consumption by 2030. In order to reach this goal, the German legislator passed the legally binding Climate Protection Act (KSG) (Elspass and Feldmann, 2020). Thus, Germany defined an offshore wind capacity target of 20 GW by 2030 and 40 GW by 2040 (Buljan, 2020; GWEC - Global Wind Energy Council, 2020a).

The legal basis for the establishment of MSP in the German Economic Exclusive Zone (EEZ) is the Federal Regional Planning Act (ROG) (European Commission, 2020). In 2019, the Federal Maritime and Hydrographic Agency (BSH) issued the Site Development Plan 2019 (FEP 2019) in accordance with the Offshore Wind Energy Act (WindSeeG) and the Environmental Reports for the North Sea and Baltic Sea of the SEA. Thus, in 2020, the BSH has set a scoping for preliminary investigation and SEA to areas to be tendered in 2024 for the construction of offshore wind farms (BSH - The Federal Maritime and Hydrographic Agency, 2020c; 2020d).

4.2.1. Environmental licensing process of offshore wind in Germany

Since 1997, offshore wind farms in the German EEZ, between 12 and 200 nautical miles in the North and Baltic Seas, are regulated by the

Fig. 2. The tendering procedure for offshore wind farms in England and Wales and Northern Ireland.
Source: TCE (2019a).

Fig. 3. The ScotWind Leasing procedure for offshore wind farms in Scotland.
Source: CES (2020a).

BSH, a branch of the Federal Ministry for Economic Affairs and Energy (BMWi), and the Federal Waterways and Shipping Administration (WSV), pursuant to the Federal Marine Installations Ordinance (SeeAnlV). For offshore wind farms that started operation after December 31, 2020, by the WindSeeG (BSH, 2020e). The BSH has also been responsible for the testing, approval and monitoring of wind turbines and structures (BMWi - Federal Ministry for Economy and Energy, 2015; BSH - The Federal Maritime and Hydrographic Agency, 2020a).

For offshore wind farms to be commissioned, the WindSeeG provides for a complete system change to the so-called central model (Fig. 4). The BSH investigates the areas designated in the Site Development Plan (SDP) for tendering procedure by the Federal Network Agency (BNetzA). Based on the results of the investigation, the BSH examines the suitability of the area. In the case of a positive, it declares its suitability by statutory order and the results are informed to the BNetzA for the tendering. As a last step, bidders will then apply for the right to develop wind farms on those pre-selected sites (WFW - Watson Farley & Williams, 2016; BSH - The Federal Maritime and Hydrographic Agency, 2020b). The bidder offering the lowest tariff wins the permit (Hogan Lovells, 2020; BSH - The Federal Maritime and Hydrographic Agency, 2020d).

In addition to the tender procedure, there is an open-door procedure (Fig. 5). Once the developer has secured a site, several of the major permits and licenses are bundled into a single authorization process administered by the BSH. This includes land tenure rights, environmental impact assessment and generation license (European Union, 2014).

The developers have to ensure their projects are compatible with the provisions of the German Federal Act on Environmental Conservation (BNatSchG), which transposes the EU Bird and Habitats Directives into national law. Approximately, 31% of the German EEZ of the North and Baltic Seas are designated as Natura 2000 sites (White & Case, 2019).

Based on this analysis, the BSH will decide, following review and comment of other expert agencies, such as the Federal Agency for Nature Conservation (BfN) and the population, whether the project is compatible with protecting the marine environment (White & Case, 2019). BSH-issued approvals generally authorize offshore wind farms to operate for up to 25 years and may be extended once by five years (WFW - Watson Farley & Williams, 2016).

4.3. Denmark case

Denmark is a pioneer of the development of offshore wind power. The world's first offshore wind farm was established in 1991 on the coast of Vindeby (Nielsen and Hemmer, 2018). Encouraged by policy incentives, the growing wind energy in Denmark has progressed from local and jointly owned wind turbine projects to large commercial projects steered by professional developers (Clausen and Rudolph, 2020).

Under the Energy Agreement of 2018, entered by Danish Parliament and Government, the electricity consumption will be covered by renewable energy by 2030. At the same time, energy from offshore wind turbines must contribute to 55% (COWI, 2020; KEFM - The Ministry of Climate, 2020). Also, Denmark's goal is to be independent of coal, oil, and gas by 2050 (DEA - Danish Energy Authority, 2019).

4.3.1. Environmental licensing process of offshore wind in Denmark

The rights to exploit energy from the wind in Danish territorial waters and in the EEZ are coordinated by DEA under the 2015 Danish Renewable Energy Promotion Act (RE Act) (Nielsen and Hemmer, 2018), in co-operation with the Danish Environmental Protection Agency (EPA), Danish Maritime Authority (DMA) and Danish Working Environment Authority (DWEA) (DMA - Danish Maritime Authority, 2015).

There are two different procedures for obtaining permits for OWP: tendering and the open-door. The interested company will use the DEA as a single-point-of-contact for assistance on issues related to licenses and procedures all the way through to end-of-life and decommissioning

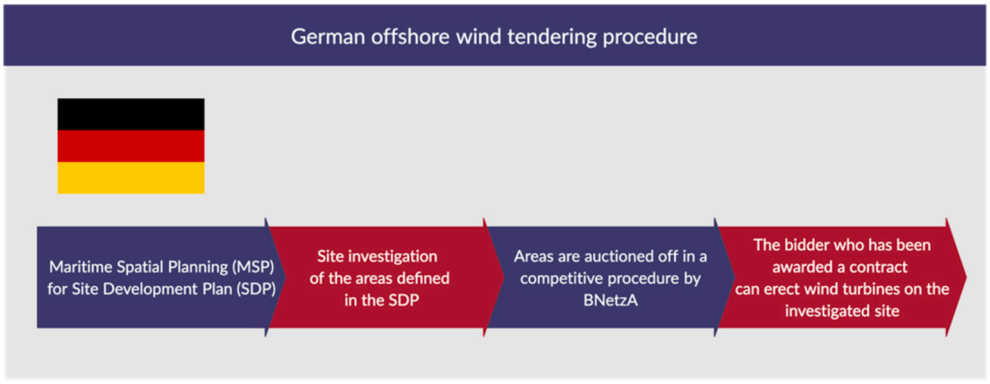

Fig. 4. The tendering procedure for offshore wind farms in Germany.
Source: Adapted from BSH - The Federal Maritime and Hydrographic Agency (2020d).

Fig. 5. The open-door procedure for offshore wind farms in Germany.
Source: Adapted from BSH (2020f).

of the wind farm (DEA - Danish Energy Authority, 2019). The DEA must grant three key permits for offshore wind farms, under the RE Act: 1) License to preliminary investigation, 2) License to construct and 3) License or authorization to produce energy (DEA, 2017, 2020a).

In the tendering procedure (Fig. 6), areas are identified in the spatial planning process by an Offshore Wind Committee, consisting of the DEA; the Danish Nature Agency (DNA), responsible for seascape, nature conservation and raw material extraction; the DMA, responsible for navigational safety at sea; the Danish Transmission System Operator (TSO), Energinet, responsible for pre-investigations and preparation of the EIA, planning and construction of the electricity transmission grid and for ensuring open and equal access to all the players in the energy market; and research centre DTU-Risø, for the establishment of criteria for wind power test areas. Based on a SEA, those areas are regulated by the Act on Maritime Spatial Planning (DMA - Danish Maritime Authority, 2015; DEA - Danish Energy Authority, 2017; Nielsen and Hemmer, 2018).

Thus, an EIA is performed before proposals are submitted. The DEA announces a tender for an offshore wind project of a specific size within a geographical area and invites applicants to submit a quotation for the price at which the bidders are willing to produce electricity in the form of a fixed Feed-in-Tariff (FiT) for a certain amount of produced electricity, calculated as number of full-load hours. The winner is awarded a concession agreement to the area tendered offshore wind farm (DEA, 2017, 2019).

In the open-door procedure (Fig. 7), the developer applies for a license to carry out preliminary investigations in a location of his choice. Then, DEA consults other government bodies to clarify whether there are other major public interests that could block the implementation of the project. In the event of a positive decision, DEA determines what the EIA should include. Once the DEA has received the EIA together with a final application to establish the offshore wind farm, it goes on public consult. If the DEA does not receive any objections, it grants a license to construct the offshore wind farm. Finally, the project developer must apply for a license to exploit wind power and, in the case of wind farms of more than 25 MW, an authorization to produce electricity (DEA - Danish Energy Authority, 2017; 2020b; Nielsen and Hemmer, 2018).

In Denmark, the developer must also consult the local fishermen and discuss potential mitigation measures or financial compensation to the estimated loss of income. As a general rule, negotiations on compensation are carried out by the Danish Fishermen's Association under the Fisheries Act. The developer must negotiate compensation with every affected fisherman, and the license to produce electricity from the offshore wind farm can be granted only if an agreement has been made with all affected fishermen. An impact assessment on commercial fisheries is prepared as part of the EIA of the predetermined offshore wind site (DEA, 2018).

4.4. *Taiwan case*

The development of OWP is relatively recent in Taiwan (Kao and Pearre, 2017). The country has become the second-largest offshore wind market in the Asia-Pacific region. International offshore developers and Original Equipment Manufacturers (OEMs) are attracted by the government's FiT, good wind resources and the government's ambitious targets to adopt clean energy (GWEC - Global Wind Energy Council, 2018, 2020c).

According to Chang et al. (2015) study of Taiwan's wind resource, the wind speeds at 100 m of high varies from 9.32 to 11.24 m/s, which means that the coastal areas of west Taiwan have good wind potential. By the end of 2019, Taiwan had 128 MW of offshore wind capacity installed at Formosa 1, its first commercial-scale offshore wind farm (GWEC - Global Wind Energy Council, 2020b). Taiwan's initial offshore wind target of 3 GW by 2025 was exceeded by over-subscription of projects proposed by developers. Taiwan will have 8.7 GW of offshore wind capacity by 2027 (AWEA - Asia Wind Energy Association, 2019).

4.4.1. *Environmental licensing process of offshore wind in Taiwan*

In Taiwan, the Bureau of Energy (BoE) of the Ministry of Economic Affairs (MoEA) is responsible for setting policies for electricity businesses and issues, regulations, and electricity generation licenses. The Industrial Development Bureau (IDB), Taiwan Power Company (TPC) and the Taiwanese Environmental Protection Administration (EPA) are the entities that coordinate the permits for OWP. The government has

Fig. 6. The tendering procedure for offshore wind farms in Denmark.
Source: Adapted from DEA - Danish Energy Authority (2017, 2019), Nielsen and Hemmer (2018).

Fig. 7. The open-door procedure for offshore wind farms in Denmark.
Source: Adapted from DEA - Danish Energy Authority (2006, 2017, 2019), Nielsen and Hemmer (2018).

generally welcomed foreign investment in its offshore wind sector, and it may be subject to BoE approval (Jones Day, 2018; WFW - Watson Farley & Williams, 2019).

The IDB is responsible for promoting and implementing Taiwan's plan for the development of the offshore wind supply chain and, amongst other activities, to approve the localization plans for each offshore wind project. Thus, the TPC is Taiwan's state-owned company power producer which has a monopoly over the country's power transmission and distribution (WFW - Watson Farley & Williams, 2019).

The EPA is responsible for the environmental standards and the coordination of actions among the various other governmental agencies. The Environmental Impact Assessment Act is administered by the EPA with support from the MOEA and in consultation with other relevant government agencies, non-governmental groups, scholars, experts, and representatives of local residents (Jones Day, 2018).

The legal basis for the development of and environmental attributes from renewable energy projects is primarily found in the Electricity Act, the Renewable Energy Development Act, and the Implementation Regulation Governing Voluntary Renewable Energy Certificates, along with other related rules and regulations (Chou and Liu, 2019). Following amendments to the Electricity Act in 2017, developers are permitted to sell renewable energy directly to end users, instead of via TPC (Pinsent Masons, 2020).

For environmental attributes, the National Renewable Energy Certification Centre was established in 2017 to formulate and implement regulations in relation to the Taiwan Renewable Energy Certificate (T-REC) mechanism, verification standards and tracking system. After the renewable energy generation equipment and production amount have been verified, the T-REC is the proof for renewable energy usage and environmental benefits (Chou and Liu, 2019).

In the promotion of offshore wind power, the Taiwanese Government has adopted a three-stage development plan: 1) Demonstration Incentive Program (DIP), 2) Zonal Application Planning (ZAP) and 3) Zonal Development (ZD) (RCG - The Renewable Consulting Group, 2018).

At ZAP, the MOEA promulgated "Directions of Zone Application for Planning" in 2015, along with 36 Zones of Potentials (ZOP) for reference of the developers (Yeap et al., 2019) and EIA has approved 20 projects (IDB - Industrial Development BureauMinistry of Economic Affairs, 2019). In Stage 3, ZD, MoEA plans to promote MSP for integration of national resources to promote installations of offshore wind power (MOEABOE - Bureau of EnergyMinistry of Economics Affairs, 2019). Also, the government does the whole planning, EIA process, and developer selection in order to save time and cost as well as establish local industry (IDB - Industrial Development BureauMinistry of Economic Affairs, 2019).

According to Jones Day (2018), to operate an offshore wind farm project, the developer must obtain an Electricity License (LE). There are six phases to be satisfied in order to obtain the electricity license (Fig. 8).

As the installation of offshore wind turbines and laying cables on the ocean floor can potentially affect the marine environment, the EIA is involved with OWP regulatory development long before any particular project planning begins (Kao and Pearre, 2017). Also, a fishery right compensation is one of the requisite documents for the application for the CP, under the Fisheries Act (Hogan Lovells, 2020). Thus, the procedure for obtaining the requisite EPA approval of the EIA is summarized also in Fig. 8. The process may vary depending on whether the project developer is required to conduct a Phase I or II to secure an environmental approval from the EPA. This is to determine whether the development activities of the project will have any 'significant' adverse impact on the environment (Pinsent Masons, 2020).

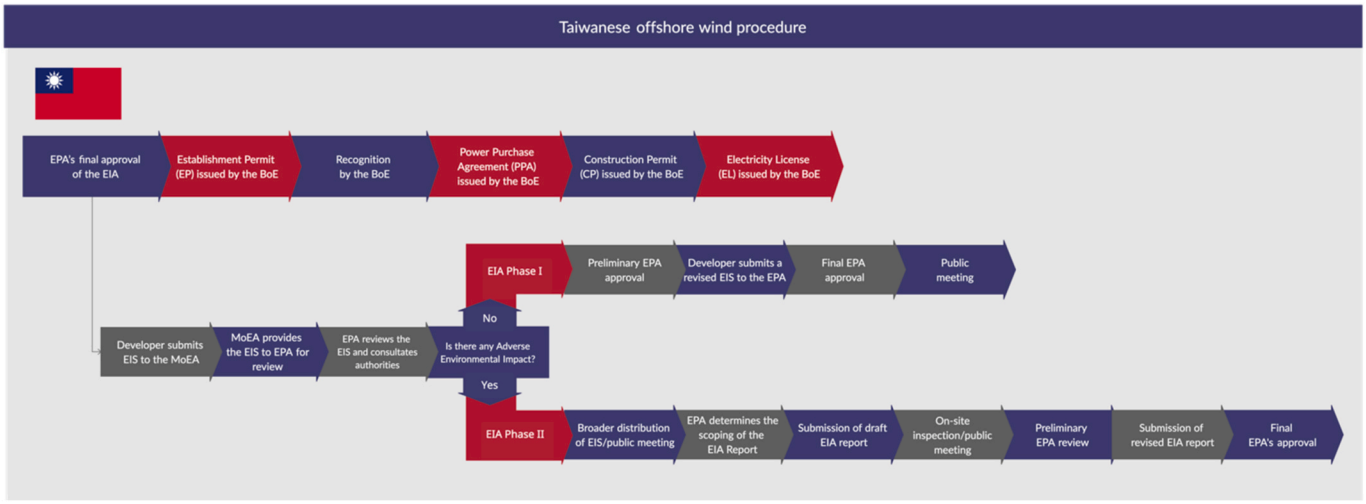

Fig. 8. The authorization procedure for establishing offshore wind farms in Taiwan.
Source: Adapted from Jones Day (2018), Hogan Lovells (2020), Pinsent Masons (2020).

5. Results and discussion

5.1. Cross-cases analysis

Through the cases analysis, differences and similarities are observed in the environmental licensing procedures among different States. For Denmark, Germany, and United Kingdom, there is a predominance of a single regulatory institution, known as one-stop-shop procedure, in which a single agency leads the process of issuing all licenses inherent to the offshore wind project and allows the approval process to be faster and more efficient. It's observed that these agencies also do consultations with the interested parties, as well as public consultations for the approval of the licenses.

In European countries, the EIA procedure is based on the European law. In addition, the Habitat and Birds Directives are present in all countries, as well as the identification of possible areas for OWP development through the MSP. On the other hand, in Taiwan, the environmental study can be an EIS or an EIA, depending on the existence of adverse environmental impacts. In addition, their respective licensing bodies determine the scope of the EIA, depending on the size of the project. Regarding MSP, in all research cases, there is a predominance of a SEA of possible suitable areas for the development of OWP.

Denmark and Germany have a licensing regime through an open-door regime, in which the developer chooses the area to be explored and submits an application to the regulatory agency for authorization. The UK has adopted the open-door regime only on the first round. In all research cases, the tendering procedure for OWP projects is available.

The public consultation is an activity that is present in all cases and, in some countries, can occur more than once. Through the consultation of the population and authorities involved, the projects of offshore wind farms can reach and consider all interested parties. In all cases, there is the initiative for maritime planning of the areas to be tendered, as well as special tariffs and subsidies to encourage the development of OWP.

Regarding the environmental permits, the licenses vary by country. However, there are some similarities, such as the licenses for exploration and investigation of the area, in the UK and Denmark; and the licenses to construct the wind farm and to produce electricity, in Denmark and Taiwan. Table 2 shows the comparison between the main aspects of the OWP environmental licensing procedures of the research cases.

5.2. Guidelines in environmental licensing of offshore wind farms

Based on literature review, technical reports, laws, and the case studies of offshore wind power in United Kingdom, Denmark, Germany and Taiwan, a set of guidelines was structured in environmental licensing of offshore wind farms for new markets (Fig. 9).

The first guideline is the ***Establishment of a national offshore wind energy production target***. In this manner, new markets should set national goals for OWP production, in which, through them, the strategies and actions for upscaling the offshore wind sector can be ensured, such as it occurs in the four research cases.

The second guideline is the ***Mapping of marine offshore wind zones***. The government of new markets needs to identify and to map, through public policies, possible areas particularly suitable for offshore wind development, as part of a prior planning process to facilitate and speed up the environmental licensing procedure. To this end, countries must invest in innovation solutions and new technologies to investigate the maritime environment.

The third guideline is the adoption of a ***One-stop-shop procedure***. For a faster and less bureaucratic procedure for licensing offshore wind projects, as is practiced in Germany, Denmark and Scotland, the new markets should adopt a single competent authority that will be responsible for granting all required authorizations to the applicants and for the coordination between other authorities involved in the process. Furthermore, it is necessary to define an Operator body for the Offshore Wind Connection Network (TSO), since it is the competent body responsible for the coordination and control of the operations of the electricity generation and transmission facilities in the country's National Interconnected System (SIN).

The fourth guideline concerns the ***Maritime land concession Regimes: Open-doors and Tenders***. Developers must be able to request specific areas for leasing through an open-doors procedure. Also, after a strategic definition of suitable areas for OWP development, considering the environmental aspects involved, the announcement of a tendering procedure must be available for potential bidders in those new markets.

The fifth guideline concerns the development of a ***Standard procedure guide in environmental licensing for offshore wind farms***, available in an official portal of the regulatory agency. In this way, the developer would be guided for all procedures and necessary documents for obtaining the environmental licenses. The procedures guide should be updated with new procedures, as experience and maturity in the procedures for implementing OWP in new markets increase, as it happened in the United Kingdom, through the announcement of new tender rounds.

The sixth guideline is the ***Development of Environmental Studies***: Environmental Impact Assessment (EIA), Strategic Environmental Assessment (SEA), and Habitats Regulations Assessment (HRA). In Taiwan, offshore wind projects are subjected to two different phases of EIA depending on the adversity of the environmental impacts. So, the development of the Environmental Impact Studies should consider the adversity of the environmental impacts. Also, in the UK, Germany, and Denmark, according to the criteria for the size of the offshore wind farm to be installed, the scope of the environmental study to be carried out is defined, as well as the licensing authority. Thus, for pilot projects, which have a lower degree of impact, a simplified study, the EIS, may be carried out. For projects with an adverse impact, a detailed EIA must be accomplished by the developer.

For the SEA studies, a competent authority may investigate future seabed areas to be leased for OWP projects to ensure a faster environmental consenting process and the protection of the marine environment. This strategy represents a general trend in all research cases.

Regarding the HRA studies, the identification of areas must be undertaken in accordance with nature conservation in EEZ, as determined by law for European countries. As a result, a competent authority must make an appropriate assessment of the implications of the project for that site regarding adverse effects on the integrity of the habitats site.

Furthermore, upon the environmental studies, the developer must clarify in each phase of the project (pre-implementation planning, project implementation and use of post-project facilities) the mitigating measures for the negative environmental impacts of the offshore wind project, in order to achieve the environmental protection goals, since the majority of GHG emissions from wind energy arise during the manufacture of turbines and construction of the plant.

The seventh guideline is the ***Public, authorities, and stakeholders' consultation***. As seen in the EIA experience of the research cases, the authorities involved, interest groups and all citizens use the public consultation stage to make comments that contribute to the final decision regarding the OWP projects. A suggestion for new markets is the development of an official online portal for this consultation, containing all offshore wind projects under approval.

Furthermore, markets should promulgate laws that determines the destination of a percentage of ownership shares to local citizens and a compensation agreement with fishermen of impacts in their economic activities upon these consultations, such as Denmark and Taiwan. In this way, developers would be contributing socially and economically to the development of new market communities. The license to produce electricity would be granted through this agreement.

The eighth guideline is the development and submission of the ***Supply Chain Development Statement (SCDS)*** for the leasing application of offshore wind areas, such as the documentation required by the Scottish leasing process. This document must describe in advance the level and location of the impacts of the supply chain of the proposed

Table 2
Comparison of the OWP environmental licensing procedures of the research cases.

	UNITED KINGDOM (England, Wales and Northern Ireland)	UNITED KINGDOM (Scotland)	GERMANY	DENMARK	TAIWAN
Licensing Authorities	•The Crown Estate (TCE) •The Planning Inspectorate for England and Wales (PINS) •Department for Environment, Food and Rural Affairs (Defra) • Marine Management Organisation (MMO) • Natural Resources Wales (NRW) • The Office of Gas and Electricity Markets (Ofgem) • Irish Department of Communications, Climate Action and Environment	•Crown Estate Scotland (CES) •Marine Scotland Licensing Operations Team (MS LOT) •Department of Communications, Climate Action and Environment	•The Federal Maritime and Hydrographic Agency (BSH) •Federal Network Agency (BNetzA) •Federal Agency for Nature Conservation (BfN) • Federal Waterways and Shipping Administration (WSV)	•Danish Energy Agency (DEA) •Energinet •Danish Fishermen's Association • Danish Environmental Protection Agency (EPA) • Danish Maritime Authority (DMA) • Danish Working Environment Authority (DWEA)	•Taiwan Ministry of Economic Affairs (MoEA) •Bureau of Energy (BoE) •Industrial Development Bureau (IDB) • Taiwan Environmental Protection Administration (EPA) • Taiwan Power Company (TPC) • National Renewable Energy Certification Centre
Consenting Regime	• Tendering rounds	• Tendering of specific areas identified under the Sectoral Marine Plan (SMP)	• Open-door • Tendering of specific areas identified under the Site Development Plan (SDP)	• Open-door • Tendering of specific areas identified under Maritime Spatial Planning (MSP)	• Open-door • Tendering of specific areas identified under Zonal Development (ZD)
Parameter adopted for the size of the project	• Projects with a capacity of more than 100 MW (MW) are classified as nationally significant infrastructure projects • Projects between 1 MW and 100MW are consented by MMO and above 100MW are consented by the PINS	Applications must have a minimum intended capacity of at least 100MW	• Between 12 and 200 nautical miles off the German coast in the North and Baltic Seas • More than 20 wind turbines taller than 50 m must undergo an EIA	• DEA criteria according to the preliminary study of the area	• EPA's criteria according to the existence of significant adverse impact on the environment
Main Normative Instruments	• Law of the Sea 1982 (UNCLOS) • Electricity Act 1989 • Habitats Directive 92/43/EEC • Electricity Works (EIA) (England and Wales) Regulations 2000 • Energy Act 2004 • Planning Act 2008 • Climate Change Act 2008 • Birds Directive 2009/147/EC • Marine and Coastal Access Act 2009 • EU Directive for maritime spatial planning (2014/89/EU) • UK Offshore Sector Deal	• Law of the Sea 1982 (UNCLOS) • Electricity Act 1989 • Habitats Directive 92/43/EEC • Planning Act 2008 • Birds Directive 2009/147/EC • Marine and Coastal Access Act 2009 • Marine (Scotland) Act 2010 • EU Directive for maritime spatial planning (2014/89/EU) • The Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017 • The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 • The Climate Change Act 2019 • UK Offshore Sector Deal	• Law of the Sea 1982 (UNCLOS) • Habitats Directive 92/43/EEC • German Renewable Energy Sources Act (EEG) • Climate Protection Programme 2030 • Federal Regional Planning Act (ROG) • Federal Marine Installations Ordinance (SeeAnIG) • Offshore Wind Act (WindSeeG) • Environmental Impact Assessment Act (UVPG) • Standard Investigation of the Impacts of Offshore Wind Turbines on the Marine Environment (StUK4) • Federal Nature Conservation Act (BNatSchG) • Birds Directive 2009/147/EC • EU Directive for maritime spatial planning (2014/89/EU)	• Law of the Sea 1982 (UNCLOS) • Habitats Directive 92/43/EEC • Danish Electricity Supply Act • Birds Directive 2009/147/EC • Executive Order n. 1476 of 2010 on impact assessment • Danish Renewable Energy Promotion Act 2015 (RE Act) • Energy Agreement 2018 • Act on Environmental Assessment of Plans and Programs and of specific projects (EIA) • Executive Order on technical certification scheme for wind turbines • The Danish Fisheries Act • EU Directive for maritime spatial planning (2014/89/EU)	• Law of the Sea 1982 (UNCLOS) • The Electricity Act (EA) • The Renewable Energy Development Act (REDA) • Implementation Regulations Governing Renewable Energy Certificates • The Environmental Impact Assessment Act • Standard of the Fishery Right Compensation regarding Offshore Wind

(*continued on next page*)

Table 2 (*continued*)

	UNITED KINGDOM (England, Wales and Northern Ireland)	UNITED KINGDOM (Scotland)	GERMANY	DENMARK	TAIWAN
Environmental Assessment Requirements	• EIS • EIA • SVIA • SEA • HRA	• EIS • EIA • SEA • HRA	• EIA • SEA • Nature Conservation Assessments for protected areas	• EIA • Impact Assessment on commercial fisheries as part of the EIA • SEA	• EIS • EIA
Environmental Licenses and Permissions	• License to exploit a development zone • Planning Consent • Development Consent Order (DCO) • Marine License • Agreement for Lease (AfL)	• Option Agreement • Permission to investigate site • Consent Application • Lease to build project • SCDS • CPS • Marine License	• Planning Permission	• Licence preliminar investigations • Licence to construct the wind farm • Licence to produce electricity • Authorization to produce electricity	• Approval of the EIA (Phase I or II) • Establishment Permit (EP) • Power Purchase Agreement (PPA) • Construction Permit (CP) • Electricity License (EL) • Taiwan Renewable Energy Certification (T-REC)

Fig. 9. Guidelines in environmental licensing for OWP in new and emerging markets.

project, broken down into each stage of the project (development and consent, construction, operation, maintenance, and decommissioning). Upon construction phase, its license must be valid for a maximum of five years and could be renewed depending on the regulatory authority's criteria. Thus, the developer is subjected to a permission to build the wind farm for a pre-established period, such as Taiwan.

5.3. Policy implications for new markets

According to ESMAP - Energy Sector Management Assistance Program (2019), offshore wind farms are potentially viable in many emerging countries to be installed in the next few years, followed by industrial deployment to bring this technology to maturity and justified by the global economy decarbonization targets and the greater participation of renewable energy in the countries' energy matrix until 2050 (IRENA - The International Renewable Energy Agency, 2020). The policy implications (see Table 3) aim to support countries (new markets) to establish environmental policy framework for offshore wind development.

6. Conclusion and policy implications

The ultimate global climate goal is to cut GHG emissions beyond 2050 to reach net-zero and potentially even zero. Considering this, renewable energy forms a fundamental part of any viable solution and OWP will be a key driver of the global energy transition. With mature markets established in Europe and the potential of the emerging countries, this industry has expected growth over the next three decades. Therefore, it is crucial to establish the environmental licensing regulations for offshore wind power projects, as the world races to completely decarbonize its power sector in line with the requirements set out by international policies.

Regarding the research question, "what are the environmental licensing regulatory guidelines and good practices that new markets should consider for the development of offshore wind projects?", the answer was obtained considering the analysis of the following information raised in the research: the literature of environmental licensing of offshore wind farms and the study of the environmental licensing process of offshore wind farms in the United Kingdom, Germany, Denmark, and Taiwan.

The proposed guidelines and policy implications aim to accelerate the development of OWP in new and emerging markets and comprise: (1) Establishment of a national offshore wind energy production target; (2) Mapping of marine offshore wind zones; (3) Adoption of a "one-stop-shop" procedure; (4) Maritime land concession regimes: Open-doors and Tenders; (5) Standard procedure guide in environmental licensing for offshore wind farms; (6) Development of Environmental Studies; (7) Public, authorities and stakeholders' consultation; and (8) Supply Chain Development Statement.

In conclusion, this article's findings cover OWP environmental regulation aspects that are of interest to international agencies, governments, public and private sector entities, local communities, and

Table 3
Guidelines and policy implications in environmental licensing for OWP in new markets.

Guidelines	Policy implications
1. Establishment of a national offshore wind energy production target	New markets government should set national target to foster the regulatory environment for offshore wind energy development in the country considering global SDGs and the Paris Climate Agreement targets.
2. Mapping of marine offshore wind zones	Offshore planning areas must be subject to terms and conditions and new markets must define a competent federal agency authorized to use this planning instrument to coordinate user interests and nature protection.
3. Adoption of a "One-stop-shop" procedure	To implement the one-stop-shop procedure, the new market should define a one-stop-shop authority which will plan and coordinate the consenting process among other relevant authorities. The main purpose is to reduce risks to developers and investors regarding unforeseen regulatory barriers in the project development phases, such as protection of the natural environment, marine cultural heritage, safety at sea, etc. Regarding the offshore wind grid, new markets should also define an operator body for the offshore wind connection network and the introduction of regulatory provisions applying to offshore wind grids. At a national level, specific rules and requirements should be designed for grid connections for the offshore transmission system development and operation, such as legal framework for transmission tariffs and incentive instruments for OWP in conformance with the environmental protection requirements.
4. Maritime land concession regimes: Open-doors and Tenders	Through policy framework, the land concession should be conducted in a government-led tender round or open-door process, both with specific rules defined by the state.
5. Standard procedure guide in environmental licensing for offshore wind farms	New markets national legislators should consider the development of a guidance document on OWP with standard terms, requirements, and provisions to be considered in environmental impact assessments of offshore wind farms under the national environmental protection law.
6. Development of Environmental Studies	Upon the environmental studies, the new markets' regulatory framework should consider different requirements and criteria for potentially significant impacts and non-significant impacts regarding OWP development activities to be included in the EIA study. Also, the adoption of SEA processes by new markets should consider a national legislative framework for the development of SEA studies. The policies and plans should integrate sustainability criteria to be evaluated by a competent authority. Under the definition of directives and regulations, in line with legislation, government policy and guidance, HRA must be undertaken by a competent authority to ensure species and habitats favorable conservation status for the protected sites. National legislators should also consider policy initiatives and environmental legislation for the evaluation of the suggested mitigation measures of negative impacts of OWP.
7. Public, authorities, and stakeholders' consultation	The rounds of consultation of citizens, stakeholders and agencies enable the developers to better understand the public response, and to meaningfully manage the social and economic aspects throughout the environmental process of the OWF. Also, efforts to manage the local citizens' and fisherman expectations about OWF development must be taken by developers to help alleviate some concerns within local communities. Also, it must be driven by a federal law to regulate this compensation agreement.
8. Supply Chain Development Statement	As a part of the leasing process, the government authority may require applicants to produce information about supply chain expenditure expected from their projects broken down by project phase and location. It supports the sustainability of offshore wind development in the country. Also, national legislators should consider the development of legal and regulatory framework for licensing consenting, including the definition of valid periods and extensions for the wind farm construction phase.

non-governmental organizations that aim to upscale sustainable energy for global energy transition, necessary for global SDGs and the Paris Climate Agreement targets. The practices suggested can be adopted by any country that aims to develop this energy source, due to its greater participation in the countries' energy matrix until 2050 (ESMAP - Energy Sector Management Assistance Program, 2019; IRENA - The International Renewable Energy Agency, 2020).

It is recommended for future research the study of adverse impacts, in relation to offshore wind projects of new markets and the study of environmental impacts mitigation, broken down by each stage of the project (development and consent, construction, operation, maintenance and decommissioning). Furthermore, studies regarding the development of strategies for reducing these negative impacts using quantitative methods such as multicriteria analysis.

CRediT authorship contribution statement

Rafael Monteiro de Vasconcelos: Conceptualization, Resources, Data curation, Investigation, Validation. **Lara Luana Cirilo Silva:** Conceptualization, Investigation, Writing – review & editing, Validation. **Mario Orestes Aguirre González:** Conceptualization, Methodology, Writing – original draft, Supervision, Validation. **Andressa Medeiros Santiso:** Resources, Data curation, Validation. **David Cassimiro de Melo:** Resources, Data curation, Validation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

All data is available at the manuscript.

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