



## OFFSHORE WIND ENERGY FOR SUSTAINABLE MARINE ECONOMIC DEVELOPMENT IN THE CONTEXT OF CLIMATE CHANGE

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### Abstract:

This research evaluates Vietnam's preparedness for its offshore wind energy program using the SWOT analytical method. The research found out that Vietnam has a lot of strengths and opportunities that makes an investment in offshore wind energy an economically viable option in the context of climate change. Despite the country's effort towards meeting the requirements for the licensing and contracting of the facility, there are still some important loopholes which could delay the process. Issues such as policy and plan, infrastructure systems, high-tech human resources, territorial sovereignty and national security are threats to the smooth implementation and operation of a offshore wind power plant. The research therefore recommended to the government of Vietnam to pay critical attention to these loopholes. Also, a particular weakness was looked at which is financing and provided some funding options for its development. Vietnam should complete the plan for offshore wind energy and develop appropriate policies and mechanisms to attract investors.

### 1. Introduction

Vietnam is speeding up industrial development, typically the aluminum industry with pilot bauxite-alumina projects which have the largest scale in Vietnam's mining industry (except oil and gas projects). This shows the determination in moving towards the development of aluminum industry lead to other industries such as manufacturing from aluminum materials, machinery, cars, supporting, etc.

Modern industrial development requires high electricity demand. Currently, the total capacity of power plants is 40GW. The electricity output in 2019 is about 226.4 billion kwh which is just enough for current demand. Also, the cost of energy is still at high level. In the current context, Vietnam has not enough conditions to develop

nuclear power. Besides, the potential of hydroelectricity has basically been exploited while the reserves of oil and gas for electricity generation are not much.

Climate change will reduce economic growth and create unsustainable growth cycles. Socio-economic development activities in many fields such as energy, industry, transportation, etc increase the concentration of gases causing "greenhouse effect" in the atmosphere and affect the global environment. Vietnam has a long coastline and is considered a country is being impacted by climate change [5]. The current trend of climate change adaptation is reducing fossil energy use and developing green energy. However,

developing wind energy on land is facing many difficulties in site clearance. Also, solar energy has limits in finding places with high heat radiation. The development of power sources is identified as Vietnam's biggest difficulty in economic development in general and heavy industry in particular.

Vietnam has high potential of offshore wind energy which is not yet exploited in a scale suitable to its potential. Vietnam has set a roadmap to develop 800 MW of wind power by 2020; 2,000 MW in 2025 and 6,000 MW in 2030. However, in reality, Vietnam's wind power development is still very limited. The total installed capacity reached about 228 MW by 2018, only 28.5% of the plan by 2020. Exploiting offshore wind energy is a sustainable direction to develop marine economy in the context of climate change. This paper uses the SWOT method to analysis the strengths and weaknesses as well as the opportunities and threats in exploiting offshore wind energy in Vietnam.

**2. Methodology**

Table 1. SWOT analysis quadrant for the development of offshore wind energy in Vietnam

<p><b>Strengths (+)</b></p> <ol style="list-style-type: none"> <li>1. Long coastline, favorable natural conditions</li> <li>2. Potential of offshore wind energy</li> <li>3. Competitive price compared to other forms of renewable energy</li> <li>4. High economic efficiency adapting to climate change</li> </ol>	<p><b>Weaknesses (-)</b></p> <ol style="list-style-type: none"> <li>1. High initial investment costs</li> <li>2. Non guaranteed infrastructure</li> <li>3. High operating costs</li> <li>4. Lack of financial mechanism</li> </ol>
<p><b>Opportunities (+)</b></p> <ol style="list-style-type: none"> <li>1. Increasing energy demand</li> <li>2. Increasing national awareness of climate change</li> <li>3. Create tourist spots</li> <li>4. Availability of foreign investors</li> </ol>	<p><b>Threats (-)</b></p> <ol style="list-style-type: none"> <li>1. Policy and plan</li> <li>2. Not availability of experienced workforce</li> <li>3. Dominance of fossil fuels</li> <li>4. National security and defense</li> </ol>

**3.2. Strengths analysis**

Vietnam, has a long coastline, favorable natural conditions and is considered to have great potential for offshore wind power, ranked in the top 10 countries with potential offshore wind power market in the world according to the ranking of the Global Wind Energy Council [3]. Offshore wind energy is converted into electricity by wind turbines

The SWOT analytical method is a strategic planning tool for assessing the strengths, weaknesses, as well as the opportunities and the threats for intended projects to help decision makers. This tool is widely used by researchers in the energy sector for energy planning such as to analysis Pakistan’s renewable energy sector [7], Ghana’s nuclear energy sector [2], Tunisia’s renewable energy market [4], Africa’s photovoltaic solar power in comparison with China [8], make a comprehensive review for East Asian countries to export green energy [1], etc. The SWOT analysis method provide information and ideas for energy plan. This research is first kind of its for the Vietnam offshore wind energy sector and is expected to help inform decision making for the sector.

**3. Results**

**3.1. SWOT analysis for the development of offshore wind energy in Vietnam**

The result of SWOT analysis is as shown as a quadrant form in table 1 which will be discussed in detail.

and is built for a longer life in accordance with extreme sea conditions. Comparing the cost of a solar plant to a offshore wind power plant which have the same capacity of 10MW in Kuwait, the production cost of wind power is 44% lower than that of solar PV [14]. Offshore wind power is a clean and zero-emission energy. This is said to be a green energy source to help sustainably developing

Vietnam's economy in the context of climate change.

Vietnam has a potential of 475 GW of offshore wind energy in waters of a depth of less than 200m [15]. The total area of Vietnam's sea depth from 0-60m is 253,483km<sup>2</sup> and the potential capacity is 151,509GW [13]. Two areas with strong wind speed are the South Central region and the area from Binh Thuan to Ca Mau. The latter has a wind speed from 7 to 11m/s and is the highest wind potential region where are almost no sea storms. The former has a wind speed from 10 to 11m/s. The coastal area of Tonkin Gulf in the north of Vietnam from Quang Ninh to Quang Tri has a wind speed of less than 6 m/s [13].

Vietnam's offshore wind power is assessed to have potential of over 600GW with a power factor of over 50%, sufficient to provide 2-2.5 times of the country's total electricity demand by 2050 [12]. Therefore, this is a very research direction that needs to be paid attention and proposed to exploit the potential of this clean energy source in the coming time to serve domestic consumption demand and develop economy.

### 3.3. Weaknesses analysis

Wind power projects with a capacity of 50-100MW require an investment of US \$80-160 million [9]. Development of offshore wind energy requires high investment capital and long payback period (from 10 to 15 years), so these projects are often difficult to attract the participation of investors.

Non guaranteed infrastructure and lack of financial mechanism are also a major barrier for investors in offshore wind power. Currently, offshore wind power projects are approved for investment but the power transmission network is limited. Many current offshore wind power projects have their capacity cut due to overloaded electrical grid. This leads to reducing the economic efficiency of projects and extending the payback period.

Offshore wind power projects are often in areas with low load. So, it takes a lot of time to build transmission lines to connect to the electrical grid. Also, very long time for compensation and clearance is also a risk for investors.

The high cost of underground cables in the power transmission makes offshore wind power in Vietnam become more expensive than other

regional countries such as Singapore and Malaysia [10].

The cost of offshore wind power is still high. European countries (UK and Germany) had it at 17 cents per kwh in 2015 and are trying to drop this cost to 12 cents per kwh by 2030 [6]. Vietnam is a developing country, so the large investment cost with long payback period makes high risks and becomes a barrier for investors.

### 3.4. Opportunities analysis

In the near future, nuclear power and non-hydro renewable power sources such as wind and solar power are projected to be the major areas of growth [11]. At present, wind turbine farms in Phu Quy islands and Bac Lieu have been operating well and brought about high economic efficiency with the payback period for over 10 years. Khai Long offshore wind farms in Ca Mau has a capacity of phase 1 of 100 MW started construction in 2016. Offshore wind farms have contributed to increasing electricity production and contributed to local budgets with stable and high tax. Currently, Bac Lieu province collected the tax of US \$3 million per year and will reach nearly US \$13 million per year when completing the 400 MW wind farm. Ca Mau province will gain more than US \$8,6 million per year of tax with a wind power project of 300 MW.

Offshore wind power projects bring high economic efficiency, ensure energy for the economy and do not cause greenhouse gas emissions. Also, it contributes to preventing coastal erosion and creating unique tourism places, learning places for students and researchers. In 2019, Bac Lieu Wind Power Area as a typical tourist destination was officially recognized by the Mekong Delta Tourism Association. Through the development of wind power projects and creating tourist attractions for the community, people's awareness of green economy development and environmental protection will be enhanced.

Many international investors have been interested and invested in offshore wind energy in Vietnam. Two offshore wind power projects has great economic value will be developed in Vietnam are Thang Long offshore wind power project in Binh Thuan province (US \$11,9 billion) and offshore wind power in Soc Trang (US \$300

million). Both of them are developed by investors from the UK.

### **3.5. Threats analysis**

Currently, Vietnam has not developed a strategy for development of offshore wind power. Offshore wind power development in Vietnam has not been integrated into marine spatial planning. This makes it difficult for investors to build projects. Also, the conflict between developing wind power projects and fisheries in coastal areas is a challenge for policy makers.

Mechanism and policy on development of offshore wind power projects such as licensing, appraisal, evaluation of environmental impacts, sea lease, carbon tax, electricity purchase price, power purchase and sale contract, supporting industries, wind power projects combined with experienced tourism, etc are still unclear and difficult to attract investors.

Offshore wind power with high levels of science and technology is a new field in Vietnam. Many investors have financial resources but are not qualified enough in technology to build and manage projects. In contrast, many investors with sufficient technological capacity cannot mobilize financial resources. The level of science, technology and human resources of Vietnam on offshore wind power is still limited.

Vietnam has not developed supporting industries related to offshore wind power projects. This leads to high operating and maintenance costs compare to solar power energy in the country.

The energy policies currently favoring the use of fossil fuels could hinder the entry of other alternative energies. The government subsidizes fossil fuels for people leads to distort the market and hinder the development of competitive alternative energy. Moreover, managers tend to pay more attention to short-term economic growth instead of long-term sustainable development. This discourages investors and businesses from investing in new areas such as offshore wind power.

Regional cooperation is indispensable for promoting offshore wind power projects. However, offshore wind power projects occupy a large area of land, so the lease of coastal land raises conflict to fisheries and the issue of territorial sovereignty and

national security when some projects has the participation of foreign investors.

### **4. Conclusions**

In the context of climate change, offshore wind power development is an indispensable solution to a long-term and sustainable future. The strength of offshore wind energy requires Vietnam to be prepared for exploiting this source at a scale appropriate to its potential. To take advantage of strengths, it is necessary to invest in researching and assessing potentials to designing projects with appropriate capacity scales.

An important weakness that needs attention is the financial issue of offshore wind energy projects. Therefore, it is necessary to implement a financial policy to support projects and to have a mechanism to ensure stable operation according to the design capacity. Opportunities for successful implementation of offshore wind energy projects in Vietnam are numerous. There have been many international investors interested in Vietnam's renewable energy development program.

Threats found are common problems for developing countries. The issue of territorial sovereignty and national security in developing countries is not as strict as in developed countries. This can lead to conflict to fisheries and skepticism for the implementation of projects in important strategic locations. Therefore, Vietnam needs to finalize its offshore wind energy development plan and integrate it into marine spatial planning. Also, publicize information and attract the attention of the community to raise their awareness in developing offshore wind energy for marine economy, towards protecting sovereignty and adapting to climate change.

The dominance of fossil fuels also hinders investors in offshore wind energy. The government should abandon subsidies and adopt policies to reduce fossil fuel use.

Finally, offshore wind projects can only be successfully implemented in the event of meeting financial needs. Therefore, it is necessary to have a financial mechanism to support these projects appropriately. As discussed above, financial factors are always a difficult problem for offshore wind energy projects, especially for developing countries like Vietnam.

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## NĂNG LƯỢNG GIÓ NGOÀI KHƠI PHỤC VỤ PHÁT TRIỂN KINH TẾ BIỂN BỀN VỮNG TRONG BỐI CẢNH BIẾN ĐỔI KHÍ HẬU

Trịnh Phương Ngọc, Trần Thị Nhung

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### Thông tin bài viết

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### Từ khóa:

*năng lượng gió ngoài khơi, phát triển kinh tế biển, biến đổi khí hậu, phân tích SWOT, Việt Nam.*

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### Tóm tắt

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Nghiên cứu này đánh giá sự chuẩn bị sẵn sàng của Việt Nam cho chương trình năng lượng gió ngoài khơi bằng phương pháp phân tích SWOT. Nghiên cứu chỉ ra rằng Việt Nam có rất nhiều thế mạnh và cơ hội khiến cho việc đầu tư vào năng lượng gió ngoài khơi trở thành một lựa chọn hiệu quả về mặt kinh tế trong bối cảnh biến đổi khí hậu. Mặc dù Việt Nam đã nỗ lực để đáp ứng các yêu cầu về cấp phép và hợp đồng đối với lĩnh vực điện gió ngoài khơi, vẫn còn một số lỗ hổng quan trọng có thể làm chậm trễ quá trình này. Các vấn đề như chính sách và quy hoạch, hệ thống cơ sở hạ tầng, nguồn nhân lực công nghệ cao, chủ quyền lãnh thổ và an ninh quốc gia là những mối đe dọa đối với việc triển khai và vận hành suôn sẻ của một nhà máy điện gió ngoài khơi. Do đó, nghiên cứu đã khuyến nghị Chính phủ Việt Nam cần hết sức lưu ý đến những nội dung này. Ngoài ra, một điểm yếu cụ thể đã được xem xét là tài chính và cung cấp một số phương án tài trợ cho sự phát triển của ngành. Việt Nam cần hoàn thiện quy hoạch năng lượng gió ngoài khơi và xây dựng cơ chế chính sách phù hợp để thu hút các nhà đầu tư.

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