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Spatial Analysis of the Potential and Development Opportunities for Ocean Current Power Plants (OCPP) in Lombok Strait

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Abstrak

Memasuki era di mana permintaan listrik meningkat, sumber energi terbarukan seperti Pembangkit Listrik Tenaga Arus Laut (PLTAL) sangat penting bagi negara-negara seperti Indonesia. Selat Lombok merupakan salah satu selat yang dilalui lintasan utama Arus Lintas Indonesia (ARLINDO) yang menjadikannya sebagai lokasi strategis untuk pemanfaatan arus laut sebagai sumber energi listrik, dengan arus minimum sebesar 4,4m/s, arus rata-rata ±5,34 m/s, dan arus maksimum sebesar 5,8m/s. Studi ini berupaya untuk menentukan area yang cocok untuk pengembangan PLTAL di dalam selat menggunakan pendekatan geografis kualitatif, menganalisis literatur dan data satelit. Penelitian ini menunjukkan bahwa kecepatan arus berkisar antara 4,44 hingga 5,8 m/s dapat menghasilkan daya rata-rata 25,92 kW, setara dengan 181.647,36 kWh per tahun. Lokasi ideal untuk penempatan turbin telah diidentifikasi pada jarak 0-75 meter dari pantai, pada kedalaman air bervariasi dari 0 hingga -100 meter. Oleh karena itu, penelitian ini menekankan perlunya pemilihan lokasi yang cermat menggunakan peta kesesuaian dan menyerukan penelitian lebih lanjut tentang sistem distribusi daya yang efektif untuk memanfaatkan potensi energi di Selatan Lombok.

Abstract

Entering an era where demand for electricity is increasing, renewable energy sources like the Ocean Current Power Plant (OCPP) are crucial for nations like Indonesia. The Lombok Strait, a key channel for the Arus Lintas Indonesia (ARLINDO) or Indonesian Throughflow, stands out as a strategic location for this technology due to its powerful currents. These currents have a minimum speed of 4.4 m/s and a maximum of 5.8 m/s, averaging around 5.34 m/s. This study sought to pinpoint suitable areas for OCPP development within the strait using a qualitative geographical approach, analyzing literature and satellite data. The research confirmed that current speeds ranging from 4.44 to 5.8 m/s could produce an average of 25.92 kW of power, equivalent to 181,647.36 kWh annually. Ideal locations for turbine placement ranging from 0 to 75 meters offshore, in water depths varying from 0 to -100 meters. Therefore, the study emphasizes the need for careful site selection using suitability maps and calls for further research into an effective power distribution system to successfully harness the strait's energy potential.

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INTRODUCTION

Renewable energy development, such as Japan's readiness to link stakeholders, is based on existing socio-economic and legal systems, as is the case with RIOE (2013) which has created a concept to synergize many local stakeholders with fisheries when implementing offshore wind power plant projects (Kularathna & Takagi, 2017). In the contemporary era of rapid development, energy consumption has emerged as an issue of increasing significance, corresponding with a perennial growth in societal demand for electrical energy (Rivera et al., 2020). Conventional energy sources, primarily fossil fuels, are characterized by their finite availability. Moreover, the utilization of fossil fuels has precipitated numerous adverse effects, including global warming and climate change (Harianto & Karjadi, 2024). Consequently, the exploration and implementation of alternative energy paradigms are imperative, following the trend of increasing carbon and fulfilling renewable energy (Bhuiyan et al., 2022). New and Renewable Energy (NRE) represents a viable alternative, not only for diversifying the energy supply but also for its minimal environmental externalities and its capacity to ensure long term energy sustainability (Neha & Rambeer, 2021).

An examination of Indonesia's national energy portfolio reveals that, according to the National Energy Council, coal remained the predominant share in 2023, constituting 40.46% of the mix. This was followed by petroleum 30.18%, natural gas 18.28%, and New and Renewable Energy (NRE) at 13.09%. Although coal's contribution decreased from the previous year's 42.38%, this reduction was not paralleled by optimal achievement in the NRE sector, which fell short of the established target of 17.87% (Paramita & Pranchiska, 2024).

Demographic expansion and industrial sector growth have rendered energy security, particularly in electricity provision, a critical imperative for sustaining societal functions and operational activities (Rivera et al., 2020). This context accentuates the potential for electricity generation via new and renewable energy sources. NRE is defined as energy derived from naturally and continuously replenishing resources, such as hydro, solar, wind, and biomass (Setyono, et al., 2019). Given Indonesia's archipelagic geography, a significant NRE potential lies in marine-based power generation, specifically through Ocean Current Power Plants (OCPP).

Ocean current energy is recognized as a consistent and environmentally benign renewable resource (Gu et al., 2024). Its inexhaustible nature stems from the continuous kinetic movement of seawater, rendering it highly suitable for the development of Ocean Current Power Plants (OCPP). Japan, specifically the Wakayama Ocean Area, is a location that has the potential for implementing the Ocean Current Power (OCP) area. This has become a project by the Prime Minister's Headquarters for Ocean Policy in Japan in 2014 (Kularathna & Takagi, 2017). In Indonesia, these strategic locations for such installations are typically found in inter island straits. The Lombok Strait, characterized by high velocity currents, presents considerable opportunities for capital investment in OCPP infrastructure. The potential of ocean currents is also under consideration in other regions with electricity deficits, such as Sabangmawang village, Natuna Regency, where reliance on small scale diesel generators is prevalent. The proximity of the Lampa Strait to the Natuna Sea indicates a potential for harnessing ocean current energy (Fahmi Setyanabi & Mulyanie, 2024). The implementation of OCPP is projected to yield positive socioeconomic impacts, including employment generation, enhanced access to affordable energy, and the stimulation of local industries like tourism.

The Lombok Strait constitutes a primary channel for the Indonesian Throughflow, positioning it as a strategic site for the exploitation of ocean currents for electricity generation. This major oceanographic feature significantly influences regional hydro oceanographic and atmospheric patterns (Sulistiyono, 2024). For the optimal design of OCPP, current velocity is a parameter of paramount importance, as turbines are employed as the prime movers for power generation. Previous research conducted by (Widiyanti, 2017) indicated that the Ampenan Beach vicinity exhibits current velocities of approximately 1.8 - 2.4 m/s, suggesting its potential as a OCPP site and an alternative energy source for the local populace (Rahmawati, 2022).

The kinetic energy inherent in ocean currents, a function of their velocity, is harnessed to drive rotors or turbines for electricity production (Rahmawati, 2022). The viability of location for OCPP development is contingent upon specific criteria. As stipulated by (Tezar et al., 2023), a prerequisite for a viable OCPP site is a location with an average peak current velocity of 1.5 m/s. Strait's function as hydrodynamically active zones where marine water masses converge and accelerate. Within these bathymetrically constricted areas, the fluid dynamics result in an amplification of current velocity, thereby concentrating the greatest energy potential relative to the surrounding waters (Inosentius et al., 2023; Rumaherang et al., 2025).

In light of the preceding background, the present study aims to analyze the potential of ocean currents as an alternative energy source and to delineate the most suitable sites for OCPP deployment in the Lombok Strait based on a tiered

METHODS

The geographical scope of this research encompasses the Lombok Strait, situated between the islands of Bali and Nusa Tenggara.

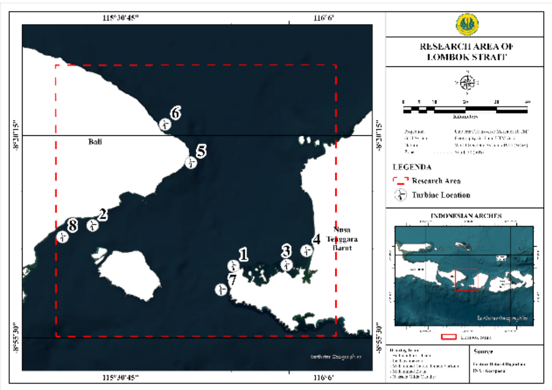


Figure 1. Research Location Map

The selection of specific study sites within the Lombok Strait was conducted using a stratified random sampling methodology based on hydro-oceanographic zoning. Stratified random sampling is used to determine heterogeneity between different units or populations in each layer in the research area. Sample points were chosen at a distance of 10-30 meters from the coastline, extending into the open sea, following the protocol established (Rahim et al., 2021).

Tabel 1. Parameter Proses Segmentasi *OBIA*

No	Coordinate	
	X	Y
1	115,8390	8,7158
2	115,4309	8,5986
3	115,9931	8,7132
4	116,0507	8,6722
5	115,7157	8,4164
6	115,6409	8,3051
7	115,8030	8,7853
8	115,3437	8,6319

Source: Research results, 2025

This study employs a Qualitative GIS (Geographic Information Systems) approach that integrates non-numeric data into a mapping platform and Geo narratives analysis (Shao et al., 2022). Current velocity data was obtained from NOAA with the average annual ocean currents in Indonesia (Purba et al., 2015). Primary mode of data acquisition was a comprehensive literature review to gather secondary data, which was subsequently processed into cartographic and tabular formats. The software used to process the data is ArcGIS Pro 3.5.3 and Ocean Data View 5.7.0 applications to see the currents, depths, and suitability of the potential for current power generation. Literature review is a systematic method of data collection involving the identification, documentation, and critical evaluation of existing physical and digital scholarly works to assess the development and hypotheses of the research field (Fadilla et al., 2022). This research involved aggregating extant data concerning ocean currents and their corresponding electrical potential, measured in kilowatt hours (kWh), within the Lombok Strait.

The Qualitative Geography method was utilized to apply a scientific and cartographic framework for analyzing phenomena and identifying patterns of spatial distribution on the Earth's surface (Yan et al., 2023) Concurrently, descriptive analysis was used to systematically classify and articulate the available data, thereby providing a qualitative assessment of the potential energy that can be harnessed from ocean currents in the Lombok Strait (Inosentius et al., 2023)

Given Indonesia's archipelagic geography, its numerous straits present a significant opportunity for the implementation of Ocean Current Power Plants. To harness this potential, it is essential to estimate the electrical energy output of a generator. The conversion of the kinetic energy of ocean currents into electrical energy is determined using the governing equation **(1).**

$$P = \frac{1}{2}\, x\, \rho\, x\, A\, x\, v^3 x\, \eta \qquad \textbf{(1)}$$

Source: (Ratomo et al., 2016; Supian et al., 2013).

P = Power generated (Watts)
ρ (rho) = Density of seawater (assumed to be 1025 kg/m3)
A = Turbine cross-sectional area (assumed to be 10 m^2)
V = Current velocity (m/s)
H (eta) = Golov turbine efficiency (assumed to be 35% or 0,35)

The efficiency factor, eta (eta), is incorporated as a weighting coefficient in the equation. Its purpose is to ensure the calculated energy conversion more closely approximates the actual electrical output of a real-world generator by accounting for turbine related energy losses. This allows the potential power of the ocean current to be calculated for various water column depths.

Determination of Net Generation, to

ascertain the total net power output, the following calculation is performed **(2)**:

Net Generation (**kWh$_{out}$*****)*** *= P(kW) x Power Factor x Hours x Days* **(2)**
Source: (Rahmawati, 2022).

With the following parameters:
Power Factor = 80% or 0.8
Hours = 24 hours/day
Days = 365 days/year

The Net Generation value represents the net power supplied to the consumer after accounting for operational factors, as opposed to the total gross energy produced by the plant (Rahmawati, 2022).

The delineation of suitable areas for OCPP installation was performed using an overlay intersect analysis. This geospatial technique integrated bathymetric and ocean current data layers for the Lombok Strait. The analysis was based on an evaluation of water depth and current velocity conditions (Keanu Can & Dartanto, 2023), with the resulting classification presented in tabular format.

Table 2. Categorizes Water Depth Suitability Level

Suitability Level	Depth Range	Current Velocity
Highly Suitable	A medium to deep depth range considered optimal 20 – 60 meters.	>5 m/s
Moderately Suitable	A medium depth range, or depths slightly exceeding 60 meters but not reaching extreme levels. 15 - 40 meters or >60 meters.	<5 m/s
Unsuitable	Depths that are either too shallow or excessively deep for effective installation or operation. < 10-15 meters or > 80-100 meters	<3 m/s

Source: (Keanu Can & Dartanto, 2023).

To evaluate the feasibility of potential sites, this study employs a suitability classification framework that integrates both bathymetric and hydrodynamic parameters, based on the criteria established by Keanu Can & Dartanto (2023). The location is designated as highly suitable if it presents a strong current velocity greater than 5 m/s within an optimal installation depth of 20 to 60 meters. Sites are considered moderately suitable if they feature a current velocity below 5 m/s at depths of either 15 to 40 meters or greater than 60 meters. A location is deemed unsuitable for development if the current is weaker than 3 m/s, or if the water is either too shallow, less than 10-15 meters, and excessively deep, greater than 80-100 meters, as such conditions would pose significant challenges to installation and operation.

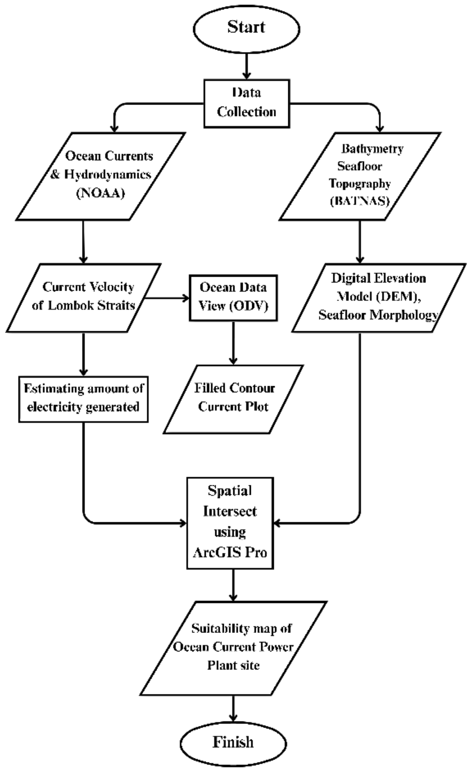


Figure 2. Current Velocity Map of Lombok Strait
Source: Research results, 2025

All data was obtained using secondary sources and processed using mapping software application. The obtained data, such as ocean currents, were calculated using current velocity to electricity conversion. The data was also filled with contour plots to determine the magnitude of the currents in the cardinal directions. Meanwhile, bathymetric data was used to determine the suitability of the area based on previously established criteria, which were then intersected with ocean current data, thus creating a map of the suitability of potential ocean current power plants.

RESULTS AND DISCUSSION

1. Current Dynamics in the Lombok Strait

The hydrodynamic conditions of the Lombok Strait, including quarterly patterns and variations during the spring/neap tidal cycle taken as an average over a year, were compiled into a tabular format using data from the Indonesian Agency for Meteorology, Climatology, and

Geophysics, and the National Oceanic and Atmospheric Administration (NOAA). The collected data becomes geospatial results on one map as seen in fig. 3.

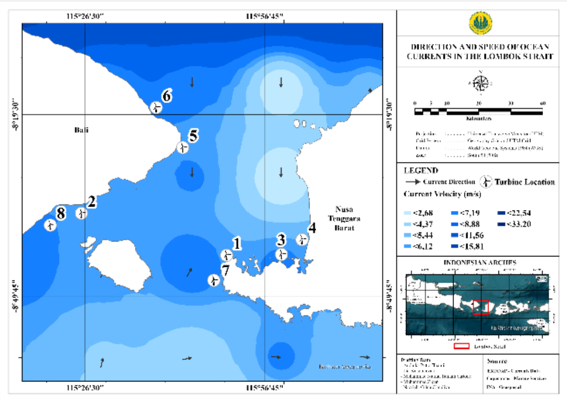


Figure 3. Current Velocity Map of Lombok Strait

Current velocity distribution reveals that the highest speeds are concentrated within the central and southern parts of the strait, particularly in the narrower channels between Bali, Nusa Penida (implied location of points 1, 3, 4, 7), and Lombok (Nusa Tenggara Barat). Observation points such as 5, 2, and 8, located along the eastern coast of Bali, are situated in areas with exceptionally high velocities, as indicated by the darker blue shading. This corresponds directly with the tabular data previously analyzed, confirming these sites as having immense kinetic energy potential. Conversely, the areas closest to the coastlines of Lombok exhibit a more varied but still significant current strength.

Table 3. Current Velocity & Bathymetry

No.	Current m/s	Bathymetry (m)
1	4,44	50-100
2	5,2	50-100
3	5,3	0-50
4	5,42	50-100
5	5,8	0-50
6	4,5	0-50
7	5,2	50-100
8	5,78	0-50
Mean	**5,34**	**-**

Source: Research results, 2025

An analysis of the data presented in Table 3 provides a comprehensive assessment of eight observation points within the Lombok Strait, offering foundational data on current velocity and bathymetry to determine the feasibility of Ocean Current Power Plant (OCPP) development. The findings reveal exceptionally high current velocities across all sites, ranging from 4.44 m/s to a peak of 5.8 m/s, with a robust mean of 5.34 m/s. These speeds significantly exceed the typical operational thresholds for marine turbines, confirming the region's immense kinetic energy potential. Furthermore, the sites are categorized into two distinct bathymetric zones, a technically favorable shallow to medium depth range of 0-50 meters and a challenging deeper zone of 50-100 meters. By integrating these parameters, a clear hierarchy of site suitability emerges. Notably, point 5 (5.8 m/s) and Point 8 (5.78 m/s) are identified as the most promising candidates, as they uniquely combine the highest velocities with the more accessible 0–50-meter depth, offering an optimal balance of high-power potential and installation feasibility. While other locations with strong currents in deeper waters remain highly viable, they may involve greater engineering complexity and cost. Ultimately, the data provides compelling, granular evidence that supports Lombok Strait's status as a prime location for OCPP projects and allows for a prioritized approach to site selection.

Table 4. Conversion Rate of Current Velocity

No.	kiloWatt conversion
1	15,7
2	25,22
3	26,70
4	28,56
5	34,99
6	16,34
7	25,22
8	34,63
Mean	**25,92**

Source: Research results, 2025

Following the acquisition of current velocity data from designated sample points, the potential power conversion at each location was calculated using the governing equation (1). The results of this conversion are presented in Table 4.

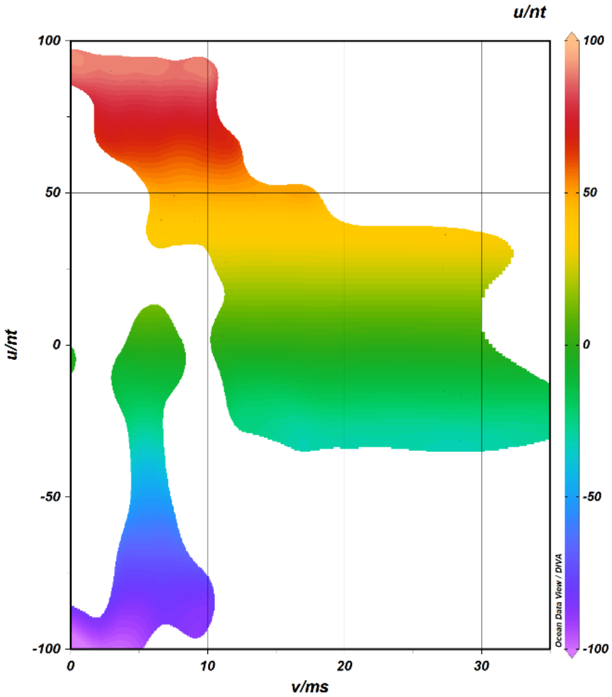
An examination of Table 4 reveals the direct conversion of ocean current energy into electrical power for each observation point. These values were derived by applying Equation (1) to the current velocity data from Table 3. The observation point exhibiting the highest power conversion potential is Point 5, with a calculated output of 34.99 kW. This corresponds to the highest recorded current velocity of 5.8 m/s. This means a small decrease in current speed would result in a much larger decrease in power output. The mean power generated across all eight observation points is 25.92 kW, indicating a significant energy potential available for exploration and exploitation from the ocean currents at these locations (Tezar et al., 2023). Compared to turbine value generated in the Sunda Strait, it has a magnitude of 23,059 watts or equivalent to 23.05 kW, this value shows the magnitude of the electricity generated in the Sunda Strait has similar potential that can be further developed for ocean current power plants (Supian et al., 2013). Both are currently located in strategic areas close to residential areas and economic development areas for local regional income.

The net annual energy generation was calculated using Equation **(2)** as follows:

Net Generation (**kWhout**) = *P(kW) x Power Factor x Hours x Days*

= 25,92 x 0,80 x 24 x 365
= 181.647,36 kWh/year

This calculation provides a realistic estimate of the total usable electrical energy a potential Ocean Current Power Plant (OCPP) in the Lombok Strait could generate annually. By starting with the average continuous power output of 25.92 kW, the formula incorporates a crucial power factor of 0.80, which realistically accounts for operational downtime due to maintenance, transmission inefficiencies, and natural variations in current speed. This adjusted power is then extrapolated over a full year of continuous, 24-hour operation (365 days) to arrive at the final net energy output. The resulting 181,647.36 kWh per year represents amount of energy that could be supplied to the local grid, serving as a key metric for assessing the project's practical impact and economic viability for powering local communities.



Source: Ocean Data View, 2025
Figure 4. Filled Contour Current Plot ODV Bali Sea - Indian Ocean

This filled contour plot provides a diagnostic representation of the horizontal structure of ocean currents by mapping the statistical distributions of zonal (east west) and meridional (north south) velocities. The resulting visualization depicts different dynamic dominion within the water column with color contours corresponding to the magnitude of the zonal velocity components. Morphology of these velocity distributions dominates flow dynamics beyond simple vector averages to depict the full spectrum of horizontal current behavior.

Interpreting the geometry of the contoured area allows for a nuanced understanding of the region's complex hydrodynamics. Irregular boundaries and distinct color-coded masses indicate the interactions and confluence of different water bodies, highlighting zones of significant horizontal shear and variability. For example, elongated features and isolated pockets within the plot indicate the presence of mesoscale phenomena such as eddies or current meanders, which are fundamental to the transfer of heat, salt, and biogeochemical properties.

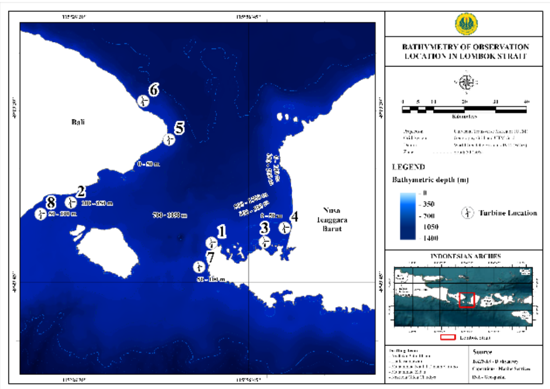
The spatial distribution of contour polygons on the Y-axis indicates highly variable zonal (east west) current components. Positive values (red/orange) denote an eastward component, while negative values (blue/purple) denote a westward component. In the Lombok Strait, currents with a velocity of 0-10 m/s are primarily distributed from the west towards the center, indicating a very weak zonal component.

The Lombok Strait exhibits a dominant eastward flow towards the Indian Ocean, with velocities ranging from 4.57 to 6.72 m/s. Stronger currents originating from the northern waters (Bali Sea) amplify the current velocity within the strait (Ratomo et al., 2016; Tezar et al., 2023). This inherent hydrodynamic power positions the Lombok Strait as a prime candidate for OCPP development, which necessitates a spatial analysis integrating current velocity with corresponding bathymetric data.

2. Bathymetry of the Lombok Strait

To identify suitable installation sites, bathymetric data of the Lombok Strait was acquired via BATNAS satellite imagery. This data is a critical consideration for the strategic placement of OCPP infrastructure. The strait features significant depth variation. Suitable locations are typically situated within the littoral zone (neritic-epipelagic), in proximity to the islands of Lombok and Bali, at depths ranging from 0 to -100 meters.

The complex bathymetric profile, a result of its geological characteristics, contributes to its strong tidal currents. This bathymetry also influences the formation of internal waves, which in turn affect surface water movement. During the east monsoon season, wave heights in the Lombok Strait can range from 0.5 to 2 meters or higher (Alifa Ramadhani, 2023).



Source: Research results, 2025
Figure 5. Bathymetry Map of Lombok Strait

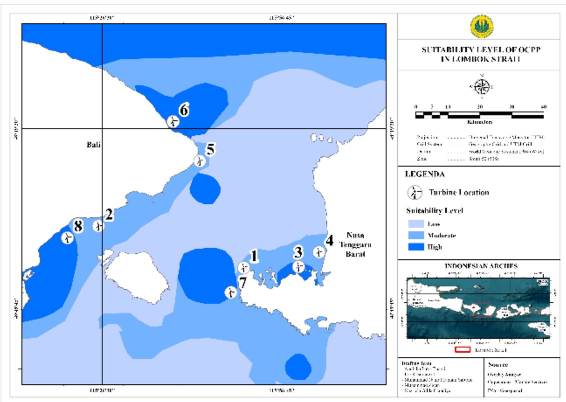
A foundational step in identifying suitable locations for an Ocean Current Power Plant (OCPP) is contingent upon a detailed understanding of the region's seafloor topography (Tian et al., 2024). For the Lombok Strait, this is accomplished by analyzing authoritative data from BATNAS (National Bathymetry) satellite imagery, which is essential for accurately mapping the underwater landscape. This bathymetric profile is not merely a geographical feature; it is a critical dataset that directly informs the strategic placement, engineering design, and overall feasibility of the entire OCPP infrastructure.

The most promising sites for development are consistently located within the littoral waters of the neritic epipelagic zone, specifically in the areas near the islands of Lombok and Bali. This zone, which corresponds to a depth range of approximately 0 to 100 meters, offers a strategic balance. It is sufficiently deep to access the powerful and stable currents needed for energy generation while remaining shallow enough to ensure that the installation, operation, and maintenance of the turbines are both technically practical and economically viable.

Furthermore, the powerful tidal currents of the Lombok Strait are intrinsically linked to its distinct physical geography. The strait's coarse and irregular bathymetry acts as a natural funnel for the vast water volumes of the Indonesian Throughflow, significantly accelerating the current's velocity. However, this same rugged seafloor topography also introduces engineering challenges. As fast-moving water flows over underwater ridges and seamounts, it can induce powerful internal waves, creating significant hydrodynamic stress on any submerged structures. This, combined with seasonal surface waves that can exceed two meters, underscores the demanding operational environment that must be meticulously accounted for in the turbine and foundation design.

3. Suitability Analysis for OCPP in the Lombok Strait

The analysis of hydrographic and bathymetric data from the Lombok Strait confirms the region's exceptional viability for renewable energy generation. All surveyed points recorded current velocities between 4.44 m/s and 5.8 m/s, with a mean of 5.34 m/s. These figures are significantly above the standard 1.5–2.5 m/s operational threshold for Ocean Current Power Plants (OCPP), underscoring the immense and consistent kinetic energy potential available for development.



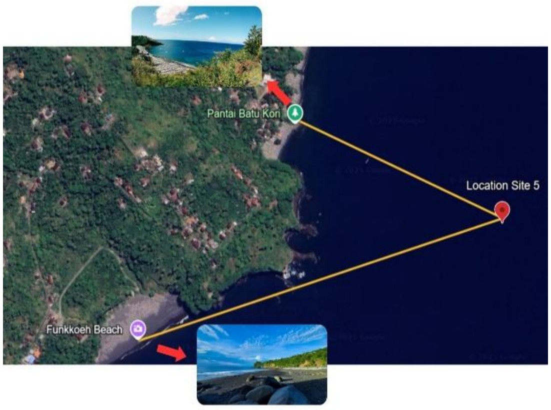
Source: Research results, 2025

Figure 6. Suitability Map of OCPP in Lombok Strait

From a technical standpoint, the project is highly feasible. The study sites feature water depths from 0 to 100 meters, a range that supports the installation of marine turbine infrastructure. The resea99rch further identifies a strategic advantage in areas with depths of less than 50 meters, as these locations offer greater accessibility and efficiency for installation and maintenance. Spatially, the analysis has produced actionable results, classifying most sites within moderate to high suitability zones and specifically designating locations 3, 6, and 8 as prime, "highly suitable" areas for initial development.

The observation sites were strategically chosen based on this combination of high kinetic energy potential and optimal water depths. This dual focus ensures not only efficient energy conversion by the turbines but also facilitates the practical aspects of the project, including the installation of foundations, long term operational access, and overall cost effectiveness.

Despite the highly encouraging technical and energy potential, a responsible path forward necessitates further comprehensive investigation. It is imperative that subsequent studies conduct thorough environmental impact assessments, evaluate the long-term sustainability of the marine ecosystem, and perform detailed socio-economic analyses. This holistic approach is crucial to ensure that any OCPP development is implemented in an effective, efficient, and truly sustainable manner for the region.



Source: Research results, 2025

Figure 7. Vicinity of Observation Point 5 (Site of Maximum Power Potential)

Based on the conversion of ocean current energy to electrical power, observation point 5 is identified as the location with the highest energy potential. Furthermore, an analysis of its surrounding area, as depicted in Figure 6, reveals its close proximity to terrestrial features. The site is located near Batu Kori beach (0.48 km away) and Pangkuh beach (0.81 km away), and the vicinity also includes residential settlements. Therefore, this location not only possesses the highest potential power but is also categorized as highly feasible and accessible. Its proximity to land significantly facilitates construction, logistical access, and energy transmission.

The selection of an optimal site for an Ocean Current Power Plant (OCPP) extends beyond identifying high velocity currents; it requires a holistic assessment of both energy potential and practical feasibility. In this context, observation point 5 emerges as a premier candidate. The initial analysis confirms that this specific location offers the highest potential for power generation among all surveyed sites, making it the most productive from a pure energy conversion standpoint. This maximum energy output establishes Point 5 as the primary focus for potential development due to its capacity to yield the greatest return on investment in terms of electricity production.

Beyond its superior energy resource, the strategic value of Point 5 is significantly amplified by its geographical advantages. As illustrated in Figure 6, the site is situated less than a kilometer from established coastlines, including Batu Kori beach (0.48 km) and Pangkuh beach (0.81 km). This close proximity to land drastically reduces the complexity and cost associated with construction and long term maintenance, as personnel and equipment can be mobilized more easily. This logistical superiority minimizes potential project delays and lowers operational expenditure over the lifespan of the plant.

The proximity of Point 5 to existing infrastructure is a critical factor for its classification as "highly feasible." The presence of nearby residential settlements implies that there is an immediate demand for the generated electricity. More importantly, the short distance to shore simplifies the most challenging aspect of offshore energy projects: energy transmission. Laying shorter subsea cables to connect the power plant to the terrestrial grid is significantly less expensive and technically less complex than spanning longer distances. This direct access to the grid and local communities ensures that the generated power can be efficiently delivered to end-users, making Point 5 a strategically sound choice for impactful and sustainable energy development.

CONCLUSION

In response to the urgent need for sustainable energy solutions within Indonesia's fossil fuel dominated energy landscape, this research confirms the profound potential of the

Lombok Strait for Ocean Current Power Plant (OCPP) development. The investigation revealed that the strait possesses exceptionally strong and consistent ocean currents, with velocities that substantially surpass the minimum operational requirements for existing power generation technology. Through a spatial analysis integrating this powerful hydrodynamics with complex bathymetric data, this study has delineated specific zones of varying suitability, effectively transforming a theoretical resource into a mapped and verifiable asset. These findings provide empirical evidence for regional policymakers to prioritize marine renewable energy investments in the Lombok Strait under the National Energy Master Plan. Therefore, while the Lombok Strait represents a significant, untapped source of clean energy, its successful exploitation is contingent upon meticulous site selection guided by the detailed suitability maps produced herein, and the subsequent development of a robust strategy for electrical power distribution. To fully realize this potential, future studies should integrate seasonal current variations, marine ecological constraints, and a thorough cost benefit analysis of submarine cable installation.

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