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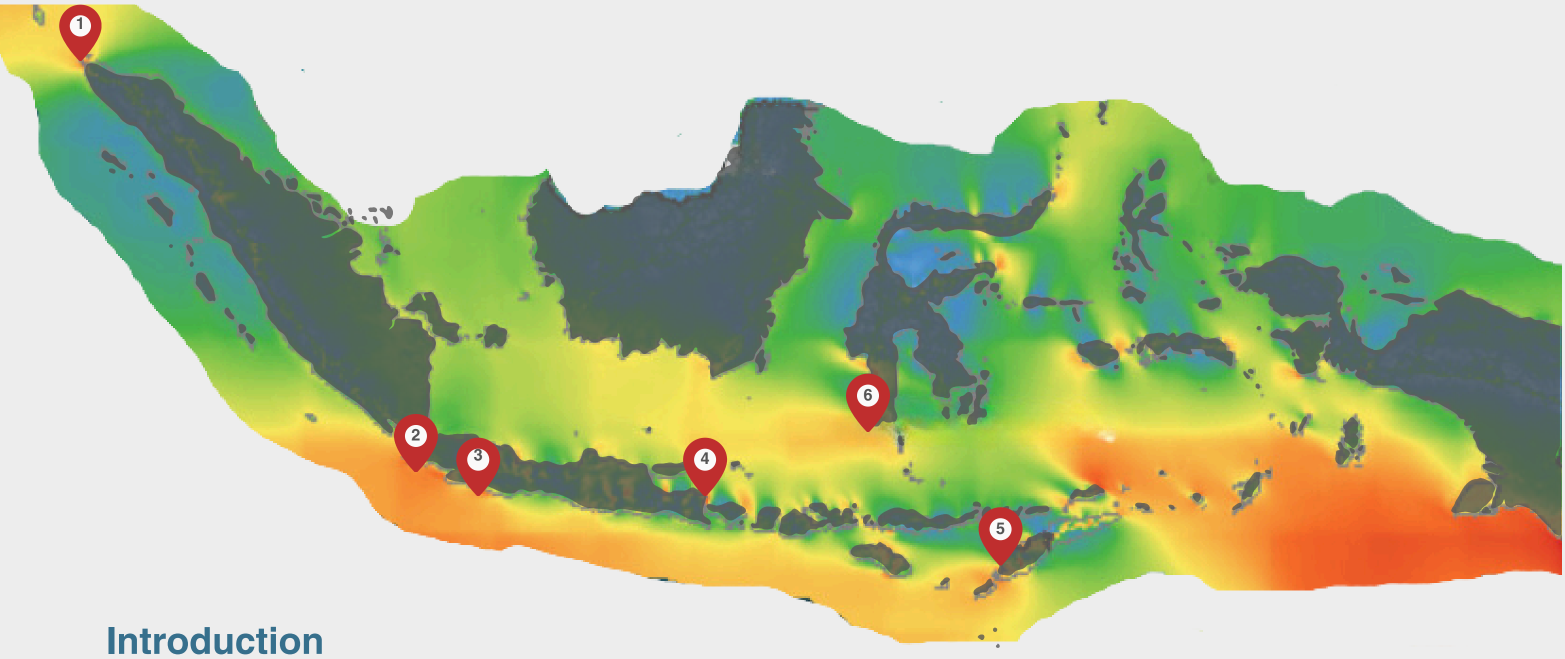
This study is part of the European Union Climate Dialogues (EUCDs) project

PONDERA

Opportunities for Offshore Wind
in Indonesia



Introduction

This Policy Recommendation Paper will give insight into the opportunity to generate offshore wind power in Indonesia. Six of the most promising areas will be presented: Aceh (1), Banten (2), Garut (3), Banyuwangi (4), Kupang (5), and Sulawesi Selatan (6). For each area, the required (port) infrastructure will be shown, as well as the grid connection possibilities and the nearby electricity demand centers. In addition, potential technical-assistance programs to support the Indonesian ministries and SOEs to facilitate the development of offshore wind in Indonesia will be presented. This document is the executive summary of the study, the full analysis can be found in in the full report.

Despite the fact that Indonesia is not the most wind rich country (mainly due to its proximity to the equator), the results show that several interesting locations for the development of offshore wind exist in Indonesia. Designs for around 5 GW of offshore windfarm capacity have been presented in this booklet, while technical potential for several additional GW of offshore windfarm capacity near (urban) demand centers seems technically feasible to be developed (this can be assessed in future studies). These numbers do not yet take into account the 50+ GW of technical potential on the southern shore of Papua, which should be assessed separately due to a lack of electricity demand nearby. While it is beyond the scope of this study, it may be possible to use floating wind and floating solar to expand the capacity of the assessed areas.

In most of the assessed locations there is sufficient port infrastructure nearby to facilitate the Marshalling and Operations & Maintenance of the potential offshore windfarms. In addition, a grid connection point is available close to most of the assessed potential offshore wind locations. Sufficient demand for additional power will likely exist in most of these electricity systems, although grid adjustments and power balancing measures will likely be required before the windfarms can be connected.

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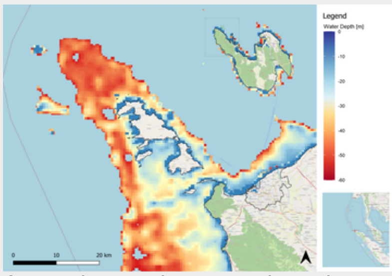
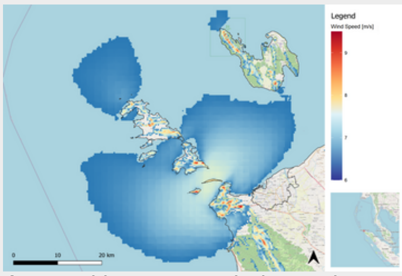
Water Depth



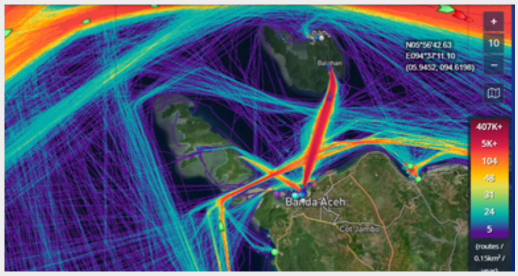
Areas deeper than 60 m have been excluded

Average Wind Speed



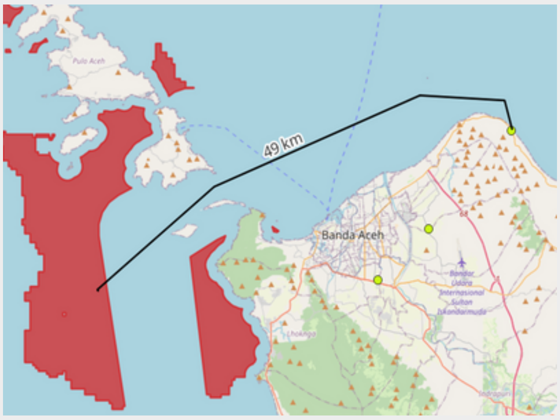
Areas with average wind speeds below 6 m/s have been excluded

Shipping Lanes, Submarine Cables, Marine Protected Areas



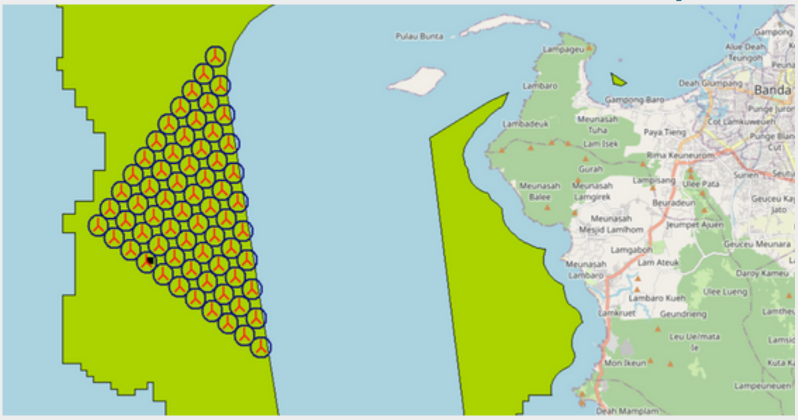
Areas within 1km from the shore, within 1 km from a submarine cable, within 2 nautical miles (≈3,7km) from a major shipping route and marine protected areas have been excluded

Potential Wind Farm Area and Nearest Grid Connection



Potential 150kV grid connection

Possible Wind Farm Design Taking Into Account Above Limitations and Assumptions



Possible wind farm design to reach around 426MW of installed capacity

Summary of Wind Farm Output

66
Number of turbines

426 MW
Total installed capacity

1,664 GWh/year
Expected electricity production

300,000
Number of household equivalents electrified

Electricity Demand in the Sumatra System

5,000 MW
Expected increase 2021-2030

3,000 MW
Estimated increase 2030-2035

3,000 MW > 426 MW
Sufficient Demand Growth to Connect Wind Farm? Yes, likely sufficient electricity demand growth will take place in this system to connect this windfarm

Port analysis

Ports near OW location	Area	Air draft	Quay width	Quay length	Quay water depth	Distance to OW area
Port Ulee Lheue	<20 ha	no constraints	< 23 m	< 250 m	< 6.5 m	< 300 km
Port of Belawan	20-40 ha	no constraints	> 50 m	> 500m	6.5-12 m	300 – 500 km
Port of Tanjung Balai Karimun	<20 ha	No constraints	< 23 m	< 250 m	< 6.5 m	>500 km
Port of Batu Ampar	>40 ha	No constraints	> 50 m	> 500 m	6.5-12 m	>500 km

The Port of Belawan meets most of the suitability criteria for marshaling ports for a potential offshore wind farm in Aceh. Available space in the port may become a limiting factor, therefore an expansion of the port area can be considered.

Important: Data used to obtain the results mentioned in this paper have been taken from the Global Wind Atlas, and have been further processed in windPRO software to calculate wind speeds and AEP. These numbers should only be used as an indication, actual wind speeds, AEP, bathymetry (Global Wind Atlas), shipping lanes (Marinetraffic.com) and available grid connection points may be different in reality and are subject to further analysis.

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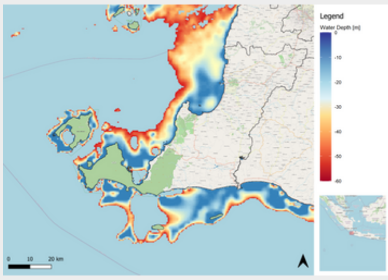
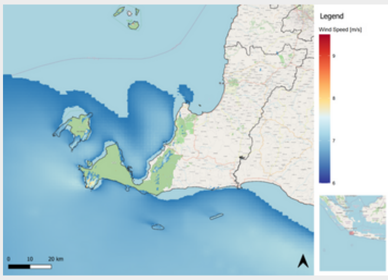
Banten

Water Depth



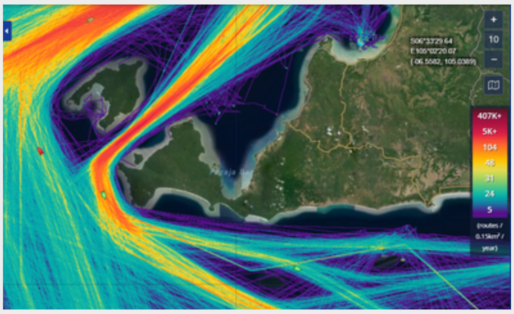
Areas deeper than 60 m have been excluded

Average Wind Speed



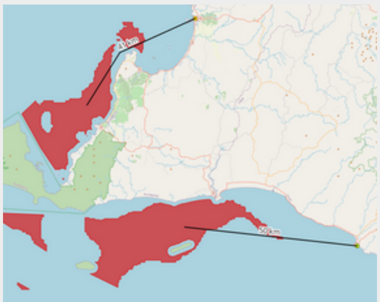
Areas with average wind speeds below 6 m/s have been excluded

Shipping lanes, submarine cables, marine protected areas



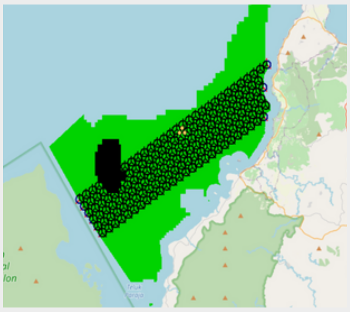
Areas within 1km from the shore, within 1 km from a submarine cable, within 2 nautical miles (≈3,7km) from a major shipping route and marine protected areas have been excluded

Potential Wind Farm Area and Nearest Grid Connection



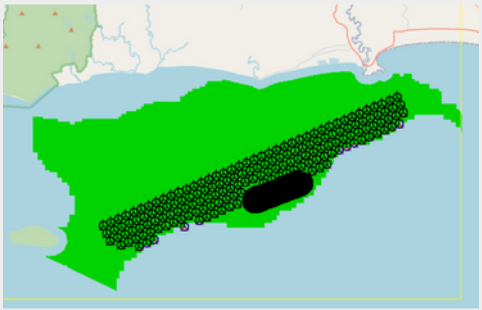
Potential 150kV grid connection

Possible Wind Farm Design Taking Into Account Above Limitations and Assumptions



Area 1 North

Possible wind farm design to reach around 1032 MW of installed capacity



Area 2 South

Possible wind farm design to reach around 1090 MW of installed capacity

Summary of Wind Farm Output

Area 1: 160
Area 2: 169

Number of turbines

Area 1: 1032 MW
Area 2: 1090 MW

Total installed capacity

Area 1: 3,574 GWh/year
Area 2: 3,908 GWh/year

Expected electricity production

Area 1: 650,000
Area 2: 700,000

Number of household equivalents electrified

Electricity Demand in the Java-Madura-Bali System

10,000 MW

Expected increase 2021-2030

5,500 MW

Estimated increase 2030-2035

5,500 MW > 2,122 MW

Sufficient Demand Growth to Connect Wind Farm? Yes, likely sufficient electricity demand growth will take place in this system to connect these windfarms

Port analysis

Ports near OW location 2	Area	Air draft	Quay width	Quay length	Quay water depth	Distance to OW area
Port of Banten	<20 ha	No constraints	23-50 m	> 500 m	>12 m	< 300 km
Port of Panjang	20-40 ha	no constraints	23-50 m	250-500 m	6.5-12 m	< 300 km
Port of Tanjung Priok Jakarta	>40 ha	no constraints	> 50 m	> 500 m	6.5-12 m	< 300 km
Port of Pontianak	>40 ha	No constraints	> 50 m	> 500 m	6.5-12 m	< 300 km

The Port of Tanjung Priok Jakarta meets all the criteria for marshalling ports and appears highly suitable to facilitate the development of offshore wind projects near Banten.

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Garut

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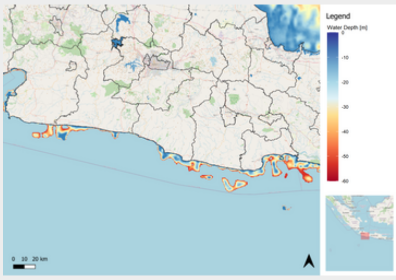
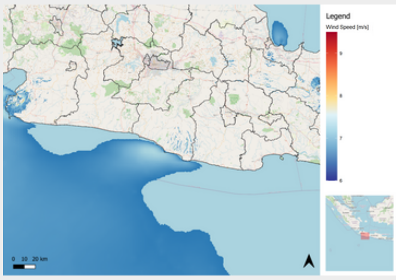
Water Depth



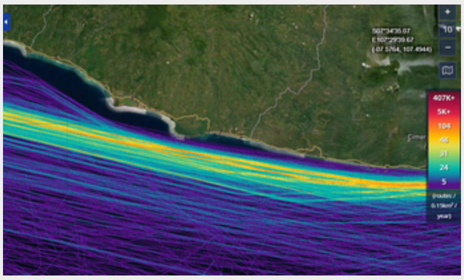
Area's deeper than 60 m have been excluded

Average Wind Speed



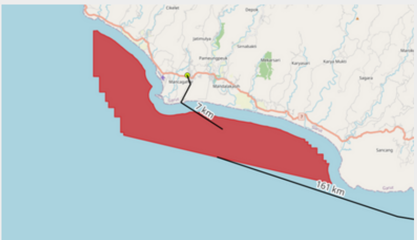
Areas with average wind speeds below 6 m/s have been excluded

Shipping lanes, submarine cables, marine protected areas



Areas within 1km from the shore, within 1 km from a submarine cable, within 2 nautical miles (≈3,7km) from a major shipping route and marine protected areas have been excluded

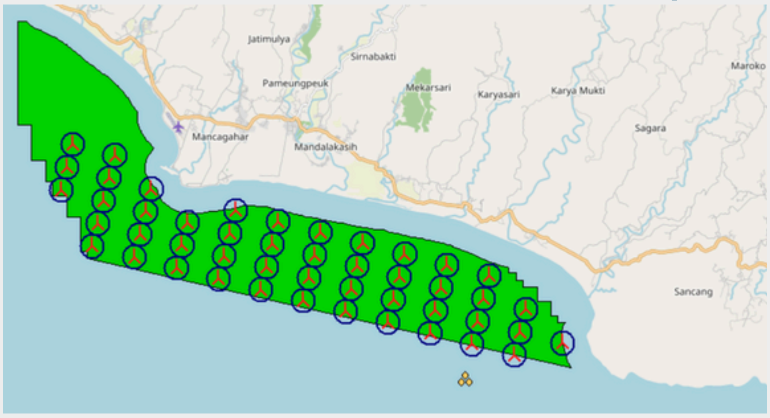
Potential Wind Farm Area and Nearest Grid Connection



Potential 70kV grid connection

Potential 150kV grid connection

Possible Wind Farm Design Taking Into Account Above Limitations and Assumptions



Possible wind farm design to reach around 302 MW of installed capacity

Summary of Wind Farm Output

47
Number of turbines

302 MW
Total installed capacity

1,125 GWh/year
Expected electricity production

200,000
Number of household equivalents electrified

Electricity Demand in the Java-Madura-Bali System

10,000 MW
Expected increase 2021-2030

5,500 MW
Estimated increase 2030-2035

5,500 MW > 302MW
Sufficient Demand Growth to Connect Wind Farm? Yes, likely sufficient electricity demand growth will take place in this system to connect this windfarm

Port analysis

Ports near OW location	Area	Air draft	Quay width	Quay length	Quay water depth	Distance to OW area
Santolo fishing port	<20 ha	No constraints	< 23 m	< 250 m	< 6.5 m	< 300 km

Currently, no nearby port is suitable for marshaling port near Garut. Further evaluation and consideration of other nearby ports, such as the **Port of Tanjung Priok or the Port of Panjang.**

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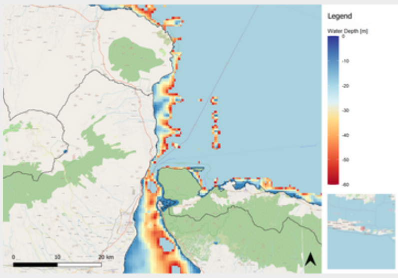
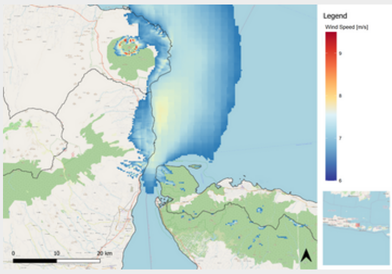
Banyuwangi

Water Depth



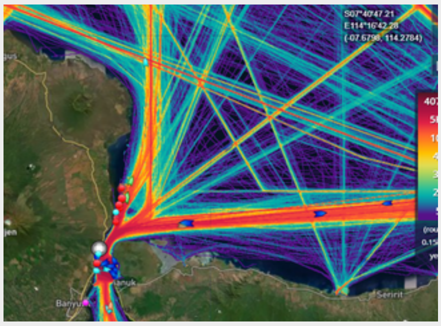
Area's deeper than 60 m have been excluded

Average Wind Speed



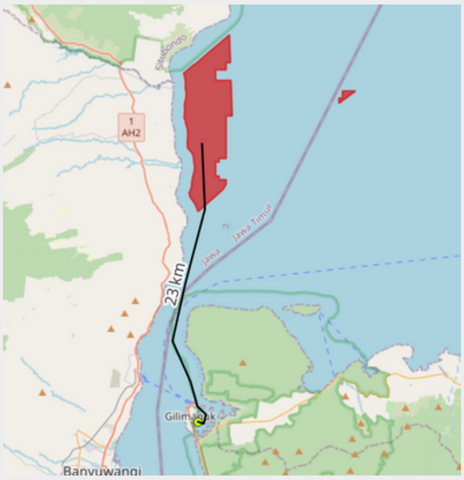
Areas with average wind speeds below 6 m/s have been excluded

Shipping lanes, submarine cables, marine protected areas



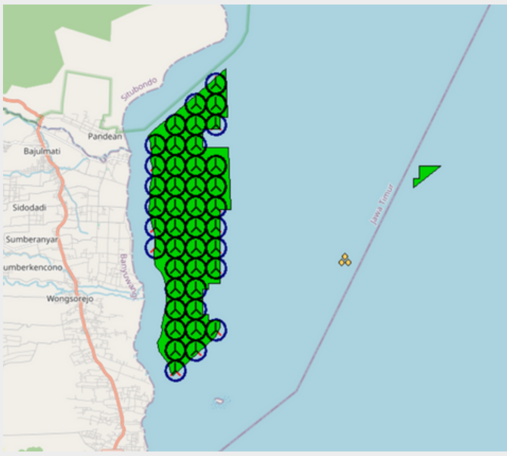
Areas within 1km from the shore, within 1 km from a submarine cable, within 2 nautical miles (≈3,7km) from a major shipping route and marine protected areas have been excluded

Potential Wind Farm Area and Nearest Grid Connection



Potential 150kV grid connection

Possible Wind Farm Design Taking Into Account Above Limitations and Assumptions



Possible wind farm design to reach around 270 MW of installed capacity

Summary of Wind Farm Output

42
Number of turbines

270MW
Total installed capacity

1,251 GWh/year
Expected electricity production

220,000
Number of household equivalents electrified

Electricity Demand in the Java-Madura-Bali System

10,000 MW
Expected increase 2021-2030

5,500 MW
Estimated increase 2030-2035

5,500 MW > 270 MW
Sufficient Demand Growth to Connect Wind Farm? Yes, likely sufficient electricity demand growth will take place in this system to connect this windfarm

Port analysis

Ports near OW location	Area	Air draft	Quay width	Quay length	Quay water depth	Distance to OW area
Port of Tanjung Wangi	<20 ha	No constraints	< 23 m	250-500 m	6.5-12 m	< 300 km
Port of Tanjung Perak	<20 ha	No constraints	> 50 m	> 500 m	6.5-12 m	< 300 km

The Port of Tanjung Perak is a potential candidate as a marshaling port for offshore wind development near Banyuwangi.

Important: Data used to obtain the results mentioned in this paper have been taken from the Global Wind Atlas, and have been further processed in windPRO software to calculate wind speeds and AEP. These numbers should only be used as an indication, actual wind speeds, AEP, bathymetry (Global Wind Atlas), shipping lanes (Marinetraffic.com) and available grid connection points may be different in reality and are subject to further analysis.

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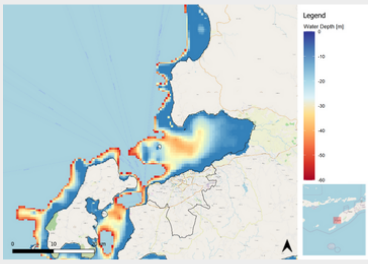
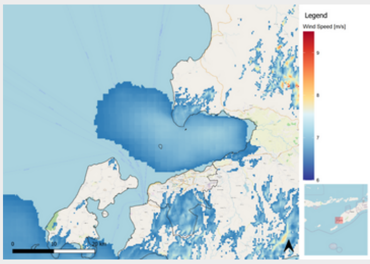
Kupang

Water Depth



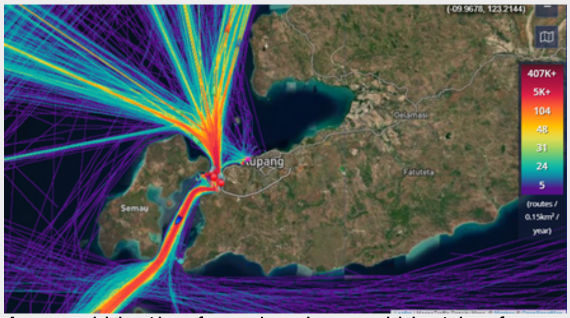
Area's deeper than 60 m have been excluded

Average Wind Speed



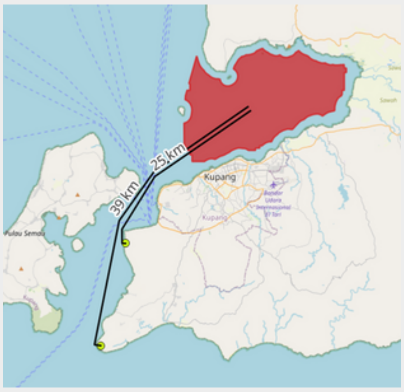
Areas with average wind speeds below 6 m/s have been excluded

Shipping lanes, submarine cables, marine protected areas



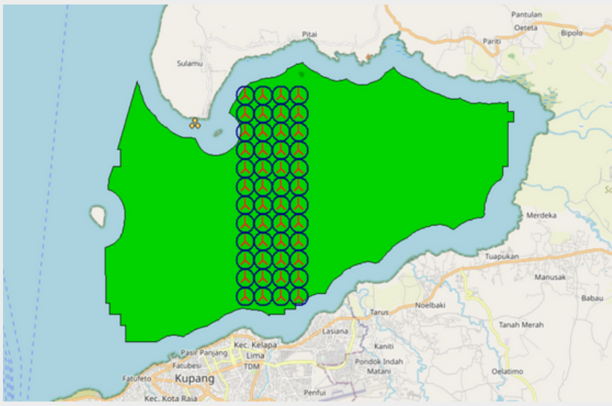
Areas within 1km from the shore, within 1 km from a submarine cable, within 2 nautical miles (≈3,7km) from a major shipping route and marine protected areas have been excluded

Potential Wind Farm Area and Nearest Grid Connection



Potential 150kV grid connection from 39km
Potential 70kV grid connection from 25km

Possible Wind Farm Design Taking Into Account Above Limitations and Assumptions



Possible wind farm design to reach around 309 MW of installed capacity

Summary of Wind Farm Output

48
Number of turbines

309 MW
Total installed capacity

1,145 GWh/year
Expected electricity production

200,000
Number of household equivalents electrified

Electricity Demand in the Timor System

150 MW
Expected increase 2021-2030

73 MW
Estimated increase 2030-2035

73 MW < 309 MW
Sufficient Demand Growth to Connect Wind Farm? No, likely insufficient electricity demand growth will take place in this system to connect this windfarm

Port analysis

Ports near OW location	Area	Air draft	Quay width	Quay length	Quay water depth	Distance to OW area
Port of Tenau	<20 ha	No constraints	23-50 m	< 250 m	6.5-12 m	< 300 km

The Port of Tenau meets certain offshore wind criteria near Kupang, but it is relatively small in size and has limited quay length. Available space in the port may become a limiting factor, an expansion of the port area can be considered.

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Sulawesi Selatan

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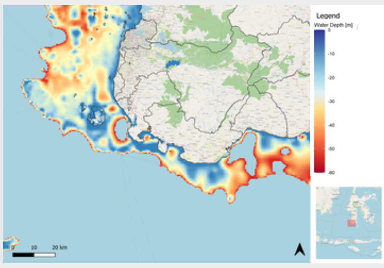
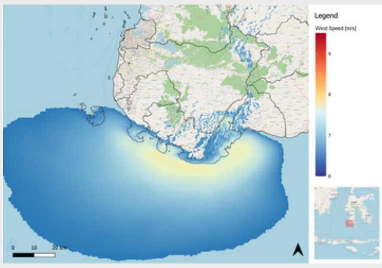
Water Depth



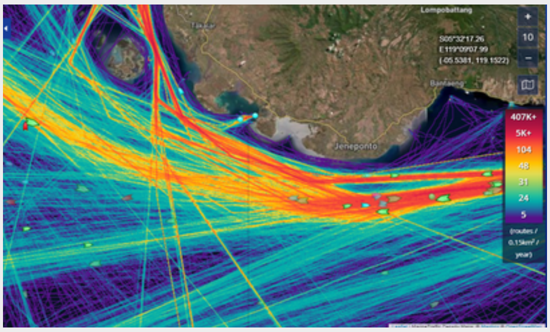
Area's deeper than 60 m have been excluded

Average Wind Speed



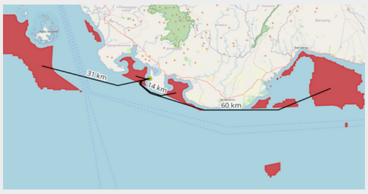
Areas with average wind speeds below 6 m/s have been excluded

Shipping lanes, submarine cables, marine protected areas

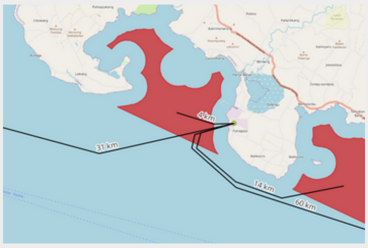


Areas within 1km from the shore, within 1 km from a submarine cable, within 2 nautical miles (≈3,7km) from a major shipping route and marine protected areas have been excluded

Potential Wind Farm Area and Nearest Grid Connection

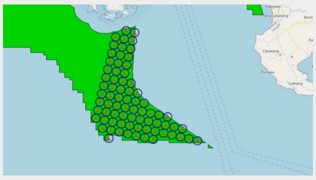


Potential 150kV grid connection

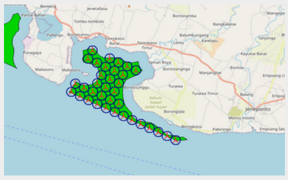


Potential 150kV grid connection

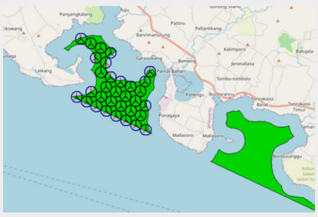
Possible Wind Farm Design Taking Into Account Above Limitations and Assumptions



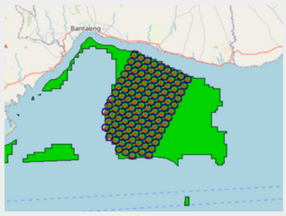
Area 1: Possible wind farm design to reach around 471 MW of installed capacity



Area 2: Possible wind farm design to reach around 206 MW of installed capacity



Area 3: Possible wind farm design to reach around 225 MW of installed capacity



Area 4: Possible wind farm design to reach around 748 MW of installed capacity

Summary of Wind Farm Output

Area 1: 73
Area 2: 32
Area 3: 35
Area 4: 116

Number of turbines

Area 1: 471 MW
Area 2: 206 MW
Area 3: 225 MW
Area 4: 748 MW

Total installed capacity

Area 1: 1,136 GWh/year
Area 2: 631 GWh/year
Area 3: 784 GWh/year
Area 4: 2,097 GWh/year

Expected electricity production

Area 1: 200,000
Area 2: 100,000
Area 3: 140,000
Area 4: 380,000

Number of household equivalents electrified

Electricity Demand in the Sulbagsel System

1,200 MW

Expected increase 2021-2030

700 MW

Estimated increase 2030-2035

700 MW < 1,650 MW

Sufficient Demand Growth to Connect Wind Farm? No, likely insufficient electricity demand growth will take place in this system to connect these windfarms

Port analysis

Ports near OW location	Area	Air draft	Quay width	Quay length	Quay water depth	Distance to OW area
Port of Bantaeng	<20 ha	No constraints	< 23 m	> 500 m	< 6.5 m	< 300 km
Port of Makassar	>40 ha	No constraints	> 50 m	> 500 m	6.5-12 m	< 300 km

The Port of Makassar is highly suitable for marshaling operations in support of offshore wind projects in Sulawesi Selatan.

Important: Data used to obtain the results mentioned in this paper have been taken from the Global Wind Atlas, and have been further processed in windPRO software to calculate wind speeds and AEP. These numbers should only be used as an indication, actual wind speeds, AEP, bathymetry (Global Wind Atlas), shipping lanes (Marinetraffic.com) and available grid connection points may be different in reality and are subject to further analysis.

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Business Models to Support Offshore Wind Development

This part of the study gives insights into how governments organize and support the pricing, subsidizing and tendering of offshore wind farms.

Examples of Support Schemes for Offshore Wind

Feed-in tariff (FIT)

A FIT means that the electricity of the offshore windfarm will be sold to the grid for a pre-determined fixed price (regardless of the market price).

Feed-in Premium (FIP)

A FIP means that a fixed amount is paid to the developer, on top of the market price. **A Feed-in Premium is currently not relevant for Indonesia, due to a lack of market dynamics in the electricity market.**

Contracts for Difference (CfD)

CfDs are effectively creating a FIT. It sets a strike price. If the market price is lower, the developer receives the difference from the counterparty. If the market price is higher, the developer pays the difference to the counterparty.

Quotas

Quotas set a minimum offshore wind capacity or percentage of offshore wind in the national energy mix by a specific date. In combination with a competitive tender, this can ensure a minimum level of project development at a feasible price point.

Current Landscape in Indonesia

Electricity Utility Structure
PLN manages generation, transmission, and fixed pricing for consumers & developers, limiting market dynamics.

Regulatory Framework
Presidential Regulation 112/2022 defines ceiling prices for renewables, but does not (yet) cover offshore wind.

Regulatory Efficiency
Limited clarity on upcoming projects and inefficient project preparation processes hinder the (offshore) wind development in Indonesia.

Navigating Offshore Wind Design in Indonesia

Enable Offshore Wind Development

Targeted Development Goals:
Set Specific, Measurable, Attainable, Realistic and Time-bound (SMART) targets for offshore wind development.

Publish a detailed Tender Schedule:
Release a clear timeline for project tenders while financing and preparing necessary studies, including wind measurement campaigns, environmental impact assessments, bathymetry (see floor) analysis, grid impact studies, etc.

Bankable Power Purchase Agreement (PPA):
Develop and publish a non-negotiable but bankable PPA, enabling developers to factor this contract into their bid submissions.

Grid Connection Responsibility:
Provide PLN with sufficient support to establish the grid connection of the offshore windfarms, including the development of an Offshore Substation and subsea cable to onshore substation.

Indirect Incentive Schemes

Financial Support:
Offer subsidized financing and fiscal incentives to offshore wind developers or service providers.

Consumer Incentives:
Introduce incentives for consumers using green (wind) electricity.

Support for Intermediaries:
Provide subsidies to organizations to work with PLN to enhance the grid.

R&D Support:
Support Research & Development initiatives in the wind energy sector (this may include the launch of a pilot project).

Carbon Pricing

Carbon Taxation Schemes:
Continue to improve the Carbon Trading and Taxing schemes, to ensure this incentivizes the transition towards renewable (wind) energy.

Get insight into international carbon pricing:
Indonesian exporters may be subject to international carbon prices. This creates financial incentives in these export oriented supply chains to reduce their carbon emissions.

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Potential for Technical Assistance (TA) Programs

The offshore wind industry is new to Indonesia; no projects have yet been prepared or developed in the country. The creation of an efficient regulatory framework to facilitate the development of the offshore wind sector is a complex task for regulators. It is expected that Indonesian policymakers can benefit substantially from experienced countries, organizations and individuals while designing such a regulatory framework. The overview below provides a list of the offshore wind related responsibilities and suggested TA and capacity building programs for the most relevant ministries and State Owned Enterprises.

	Offshore Wind Related Responsibilities	Technical Assistance and Capacity Development Program
The Coordinating Ministry for Maritime and Investments Affairs	• Coordinating, implementing, and overseeing policies in maritime and investment. • Controlling policy implementation. • Managing sector-related issues. • Supervising national priority programs and Cabinet Meeting policies. • Resolving inter-ministerial disagreement and ensuring decision implementation.	• Plan long-term offshore wind development in Indonesia with MEMR and Bappenas. • Develop a regulatory framework (including permitting system) for offshore wind with MEMR. • Establish an offshore wind development task force and execute a pilot project alongside MEMR and PLN. • Develop a Marine Spatial Plan integrating offshore wind with Bappenas.
The Ministry of Energy and Mineral Resources	• Formulate and implement energy policies. • Provide technical guidance and supervision for policy implementation in renewable energy. • Conduct research and development in renewable energy. • Implement human resource development in the renewable energy sector.	• Collaborate with Bappenas and Marves on long-term offshore wind planning. • Establish conditions for a permitting system, tendering system, and incentives, to be implemented by PLN. • Develop regulations for grid connection infrastructure. • Develop necessary regulations for pilot project execution.
The Ministry of National Development Planning	• Macro-economic planning and target setting. • Coordinating planning, budgeting, and implementation. • Allocating finances according to national priorities in strategic sectors. • Conducting studies on institutional coordination, human resources, and required financing.	• Collaborate closely with MEMR and Marves on long-term offshore wind planning. • Include offshore wind in the Marine Spatial Plan. • Contribute to the formation and execution of an offshore wind task force and a pilot project.
The Ministry of Environment and Forestry	• Develop, coordinate, and oversee sustainable environmental policies.	• Establish clear criteria for environmental impact assessments. • Collaborate with other permitting ministries for an efficient, unified process. • Lead or participate in an offshore wind task force and pilot project. • Provide input for a Marine Spatial Plan incorporating offshore wind.
The Ministry of Marine Affairs and Fisheries	• Develop, implement, and oversee (national and regional) policies for marine management, space, and environmental protection. • Organize outreach and human resource development for marine and fisheries sectors.	• Establish specific criteria for environmental impact assessments. • Coordinate with other ministries for an efficient permitting process. • Provide input for a Marine Spatial Plan incorporating offshore wind.
The Ministry of Industry	• Set local content requirements. • Formulate and implement policies to facilitate the development of an efficient offshore wind upstream industry in Indonesia.	• Develop suitable and clear local content requirements, using both experience from within Indonesia in other sectors, and succes-stories from other countries. • Develop policies & partnerships which support Indonesia to develop a strong local upstream offshore wind industry.
The Ministry of Transportation	• Formulate and implement transportation infrastructure policies. • Conduct transportation policy analysis and provide recommendations. • Implement human resource development in transportation-related fields.	• Create a strategy for adapting shipping lanes and resolving potential conflicts. • Contribute to the Marine Spatial Plan, integrating offshore wind. • Provide inputs for an efficient permitting system related to industrial activity.
The Ministry of State-Owned Enterprises	• Develop and implement policies for strategic business initiatives, competitiveness, synergy, performance, sustainable growth, restructuring, business development, and enhancing SOE business infrastructure.	• Integrate offshore wind into the new RUPTL (Electricity Supply Business Plan). • Plan and trial integrating intermittent wind power into the grid, testing hybrid projects and diverse energy storage solutions. • Contribute to forming and executing an offshore wind task force. • Offer input to MEMR for an efficient tendering system and its implementation.
Perusahaan Listrik Negara (PLN)	• Transmit and distribute electricity, managing grids and balancing activities.	• Prepare offshore wind projects, including necessary assessments like wind measurements and environmental assessments, to be procured by PLN and paid for by tender winners. • Develop grid connection infrastructure for offshore wind. • Facilitate and ensure to obtain the right learnings from pilot projects. • Design bankable Power Purchase Agreement (PPA) contracts, ideally publicize this draft.

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