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WORLD BANK GROUP

Offshore Wind Development Program

OFFSHORE WIND ROADMAP FOR THE PHILIPPINES

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CONTENTS

Figures

Tables

ABBREVIATIONS

AEP	Annual energy production
AIS	Automatic Identification System
AWC	Asian Waterbird Census
AZE	Alliance for Zero Extinction
BOOT	Build-own-operate-transfer
CAPEX	Capital expenditure
CDM	Construction, design, and management
CfD	Contract for difference
CIT	Corporate income tax
COC	Confirmation of Commerciality
CPA	Conservation Priority Areas
CREZ	Competitive Renewable Energy Zone
CTV	Crew transfer vessel
DECEX	Decommissioning expenditure
DEVEX	Development expenditure
DOC	Declaration of Commerciality
EAAFP	East Asian-Australasian Flyway Partnership
E&S	Environmental and Social
EBA	Endemic Bird Areas
EBSA	Ecologically or Biologically Significant Areas
ECA	Environmentally Critical Area
ECC	Environmental Compliance Certificate
ECP	Environmentally Critical Projects
EEZ	Exclusive economic zone
EMP	Environmental Management Plan
ENIPA	Expanded National Integrated Protected Areas System
EPIRA	Electric Power Industry Reform Act
ESF	Environmental and Social Framework
ESIA	Environmental and social impact assessment
ESS	Environmental and social standards
EVOSS	Energy Virtual One-Stop Shop
FEED	Front-end engineering and design
FID	Final investment decision

FIT	Feed-in tariff
FTE	Full-time equivalent
GCA	Grid Connection Agreement
GEAP	Green Energy Auction Program
GEBCO	General Bathymetric Chart of the Oceans
GEOP	Green Energy Option Program
GIIP	Good international industry practice
GIS	Geographical information system
GVA	Gross value added
GWA	Global wind atlas
HVDC	High voltage direct current
IBA	Important Bird Area
IBAT	Integrated Biodiversity Assessment Tool
IMMA	Important Marine Mammal Areas
INDC	Intended declared contribution
KBA	Key Biodiversity Area
KPI	Key performance indicator
LCOE	Levelized cost of energy
LGU	Local Government Unit
LMPA	Locally Managed Protected Area
LNG	Liquified natural gas
LOI	Letter of intent
LPA	Legally protected areas
MAB	Man and the Biosphere
MDB	Multilateral development bank
MLA	Multilateral lending agencies
MPA	Marine Protected Area
MSA	Metering Service Agreement
MSP	Marine spatial planning
NIPAS	National Integrated Protected Areas System
NGO	Nongovernmental organization
NREP	National Renewable Energy Program
OATS	Open Access Transmission Service
ODA	Official Development Assistance
OMS	Operations and maintenance service
OPEX	Operational expenditure
OCSP	Open and competitive selection process
OSH	Occupational Safety and Health

OSHS	Occupational Safety and Health Standards
OSW	Offshore wind
PCM	Production Cost Model
PDA	Predetermined Area
PDP	Power development plan
PDS	Predevelopment stage
PEP	Philippine Energy Plan
PEISS	Philippine Environmental Impact Statement System
PPA	Power purchase agreement
PSC	Petroleum Service Contract
PSIPP	Private Sector Initiated Power Project
RD&D	Research, design, and development
RESC	Renewable energy service contract
RESHERR	Renewable Energy, Safety, Health and Environment Rules and Regulations
REZ	Renewable Energy Zone
RORO	Roll-on-roll-off
RPS	Renewable Portfolio Standard
R&D	Research and development
SEF	Sustainable Energy Finance
SDG	Sustainable Development Goal
SOLAS	Safety of life at sea regulations
SOT	Spreadsheet Optimization Tool
SOV	Service operation vessel
SPMT	Self-propelled modular transport
SSME	Sulu-Sulawesi Marine Ecoregion
SSMP	Small Scale Mining Permit
STEM	Science, technology, engineering, and mathematics
SVC	Static var compensator
TDP	Transmission development plan
TLP	Tension-leg platform
TSA	Transmission Service Agreement
WACC	Weighted average cost of capital
WCD	Works completion date
WDPA	World database on protected areas
WESC	Wind energy service contract
WESM	Wholesale Electricity Spot Market

Company and Institute Abbreviations

ADB	Asian Development Bank
AG&P	Atlantic, Gulf and Pacific Company
ANZ	Australia and New Zealand Banking Group Limited
ASEAN	Association of Southeast Asian Nations
BDO	Banco de Oro
BFAR	Bureau of Fisheries and Aquatic Resources
BOI	Board of Investments
BPI	Bank of the Philippine Islands
BSP	Bangko Sentral ng Pilipinas, the central bank of the Philippines
BWC	Bureau of Working Conditions
CAAP	Civil Aviation Authority of The Philippines
CPA	Cebu Port Authority
DBP	Development Bank of the Philippines
DEA	Danish Energy Agency
DENR	Department of Environment and Natural Resources
DND	Department of National Defense
DOE	Department of Energy
DOLE	Department of Labor and Employment
DOTr	Department of Transportation
DTI	Department of Trade and Industry
DTU	Danish Technical University
EDC	Energy Development Corporation
EIB	European Investment Bank
EKF	Eksport Kredit Fonden
EMB	Environmental Management Bureau
EPIMB	Electric Power Industry Management Bureau
ERC	Energy Regulatory Commission
GWO	Global Wind Organization
GWEC	Global Wind Energy Council
GWNET	Global Women's Network for the Energy Transition
HHI	Hanjin Heavy Industries
IFC	International Finance Corporation
ILO	International Labour Organization
IRENA	International Renewable Energy Agency
MARINA	Maritime Industry Authority
NCIP	National Commission on Indigenous Peoples

NGCP	National Grid Corporation of the Philippines
NREB	National Renewable Energy Board
OIMB	Oil Industry Management Bureau
PPA	Philippine Ports Authority
RCBC	Rizal Commercial Banking Corporation
Transco	National Transmission Corporation
WBG	World Bank Group

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This roadmap was prepared, under contract to the World Bank, by BVG Associates in association with Arup and Puno Law. It includes a country assessment of biodiversity sensitivities undertaken by The Biodiversity Consultancy.

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EXECUTIVE SUMMARY

This roadmap provides strategic analysis of the offshore wind development potential in the Philippines, considering the opportunities and challenges under different, hypothetical growth scenarios. The goal is to provide evidence to support the Government of the Philippines in establishing policy, regulations, processes, and infrastructure to enable successful growth of this new industry.

The roadmap was initiated by the World Bank country team in the Philippines under the umbrella of the World Bank Group's (WBG's) Offshore Wind Development Program—which aims to accelerate offshore wind development in emerging markets—and was funded by the Energy Sector Management Assistance Program (ESMAP) in partnership with the International Finance Corporation (IFC).

RATIONALE FOR OFFSHORE WIND IN THE PHILIPPINES

With over 7,000 islands, the Philippines has a rich maritime history and is a renowned seafaring nation. The country's waters have conditions that are well suited to offshore wind and this abundant, indigenous energy resource offers an opportunity for the Philippines to carry out the following:

- **Improve energy security**: The Philippines is heavily reliant on imported fossil fuels. The uncertainty of future availability and price of these fuels puts the country at risk from supply constraints and price increases. Offshore wind, alongside other local renewable energy resources, could help increase energy independence and resilience, as well as help reduce the country's large trade deficit.[i]
- **Lower greenhouse gas emissions**: Emissions from the burning of coal and oil comprise around 87 percent of the Philippines' carbon emissions[ii] and total emissions are rising rapidly. Low-carbon electricity from offshore wind could help reduce energy-related emissions and help the Philippines achieve its Nationally Determined Contribution (NDC) target[iii] of peak emissions by 2030.
- **Increase renewable energy supply**: Although renewable energy generation is increasing, its overall share of the Philippines' electricity mix has decreased substantially[iv] from 34 percent of total electricity generation in 2008 to around 21 percent in 2021. The National Renewable Energy Program (NREP) sets a target of 35 percent share of renewable energy in the power generation mix by 2030 and 50 percent share by 2040. Offshore wind could contribute to the +28 GW of new generation capacity required[v] by 2030.

i IMF. 2021. "Philippines Country Report." https://www.imf.org/-/media/Files/Publications/CR/2021/English/1PHLEA2021003.ashx.

ii ICOS. 2021. "Data supplement to the Global Carbon Budget 2021." https://www.icos-cp.eu/science-and-impact/global-carbon-budget/2021.

iii UNFCCC. 2021. "Republic of the Philippines. Nationally Determined Contribution (NDC)." https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Philippines%20First/Philippines%20-%20NDC.pdf.

iv Department of Energy. 2022. "National Renewable Energy Program." https://www.doe.gov.ph/national-renewable-energy-program.

v Department of Energy. 2022. "Philippine Energy Plan 2020–2040." https://www.doe.gov.ph/sites/default/files/pdf/pep/PEP_2020-2040_signed_01102022.pdf.

- **Reduce demands for land use**: With over 22 percent of the population employed in agriculture,[vi] land in the Philippines is a precious resource. The large-scale development of onshore renewable energy is likely to compete for land and cause conflicts in some areas. By making careful use of marine areas, offshore wind could help reduce demands for land use.
- **Benefit the economy**: Offshore wind development could create local jobs, catalyze industrial growth in the supply chain, spur port and grid infrastructure upgrades and expansion, and increase inward investment.

THE PHILIPPINES' OFFSHORE WIND POTENTIAL

The Philippines' total technical potential[vii] offshore wind resource is estimated[viii] at 178 GW. Large areas around the country's coast have technically extractable wind resources. Around 90 percent of the resource is found in waters deeper than 50 meters, which will require the use of floating offshore wind turbines.

Existing data was gathered during this roadmap study and analysis was undertaken to further characterize the Philippines' offshore wind resources. This analysis assessed a wide range of environmental, social, and technical constraints to identify six potential offshore wind development zones with likely lower environmental and social (E&S) impacts associated with the development of offshore wind within these zones. Stakeholder engagement, in-depth environmental and social impact assessments (ESIAs), and power system planning will be required to better understand the suitability and development risks within these zones. The roadmap recommends undertaking these analyses as one of the priority next steps.

Figure ES.1 shows the six zones, the existing and planned electrical transmission network, and the relative levelized cost of energy (LCOE) for offshore wind projects in 2033. The combined capacity of the six zones could reach 40 GW, which is significant when compared with the Philippines' total generation capacity of around 26 GW in 2020.

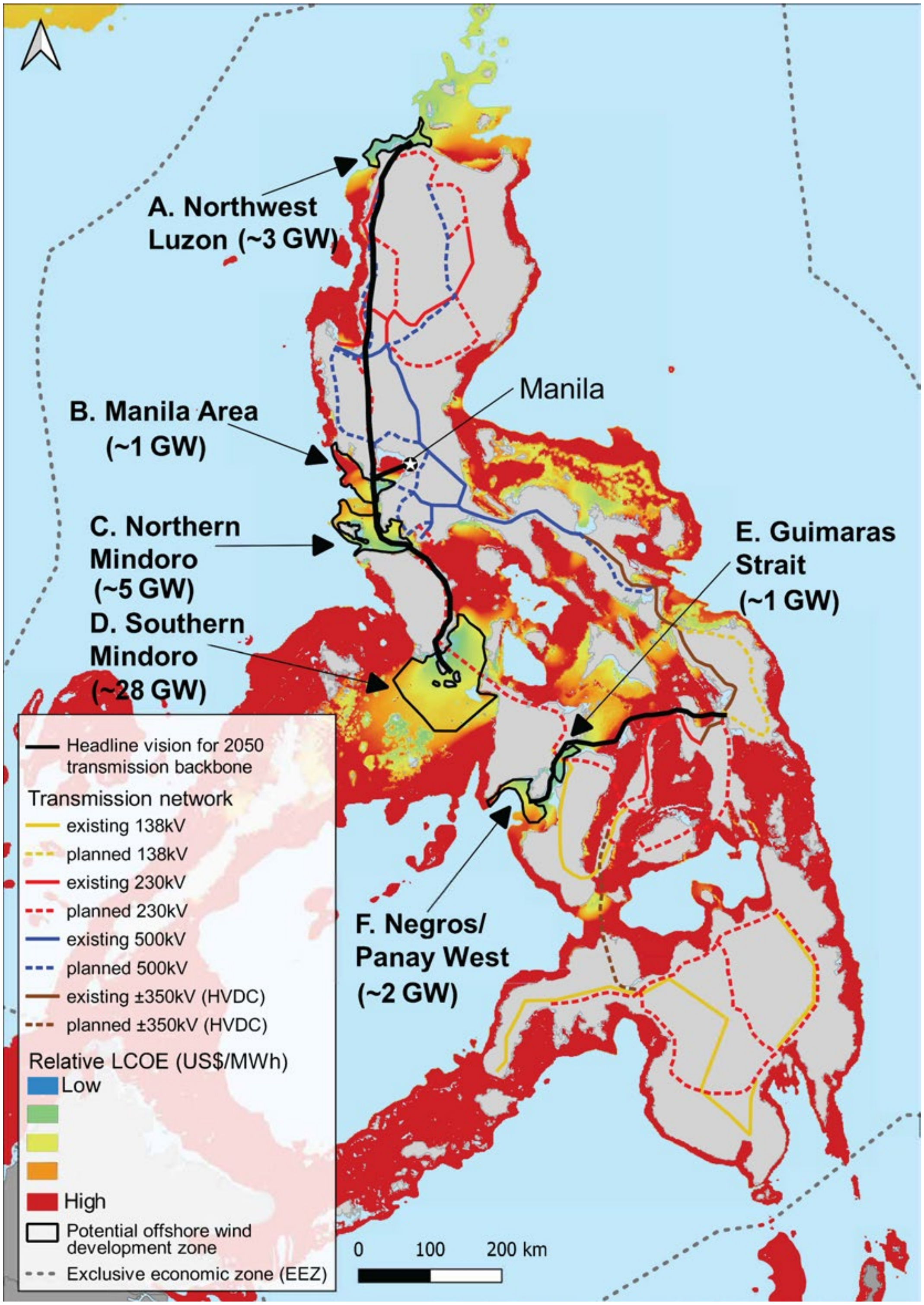
Both local and international private sector firms have already demonstrated high interest in developing offshore wind in the Philippines. At the time of writing, the Philippines' Department of Energy (DOE) had already awarded 30 wind energy service contracts (WESCs), representing plans for a cumulative offshore wind capacity exceeding 20 GW. Many of these WESC areas coincide with the zones identified in this roadmap.

vi World Bank Group. 2022. "World Bank Open Data." Data retrieved from the International Labour Organisation, ILOSTAT Database on January 29, 2021. https://data.worldbank.org/indicator/SL.AGR.EMPL.ZS?locations=PH.

vii The offshore wind technical potential is an estimate of the amount of generation capacity that could be technically feasible, considering only wind speed and water depth. This is intended as an initial, high-level estimate and does not consider other technical, environmental, social, or economic constraints.

viii ESMAP. 2020. "Offshore Wind Technical Potential in the Philippines." https://documents1.worldbank.org/curated/en/519311586986677638/pdf/Technical-Potential-for-Offshore-Wind-in-Philippines-Map.pdf.

FIGURE ES.1 THE 40 GW VISION FOR OFFSHORE WIND AND TRANSMISSION NETWORK IN THE PHILIPPINES IN THE HIGH GROWTH SCENARIO, 2050



Note: Relative levelized cost of energy (LCOE) is for 2033.

SCENARIOS FOR DEVELOPMENT

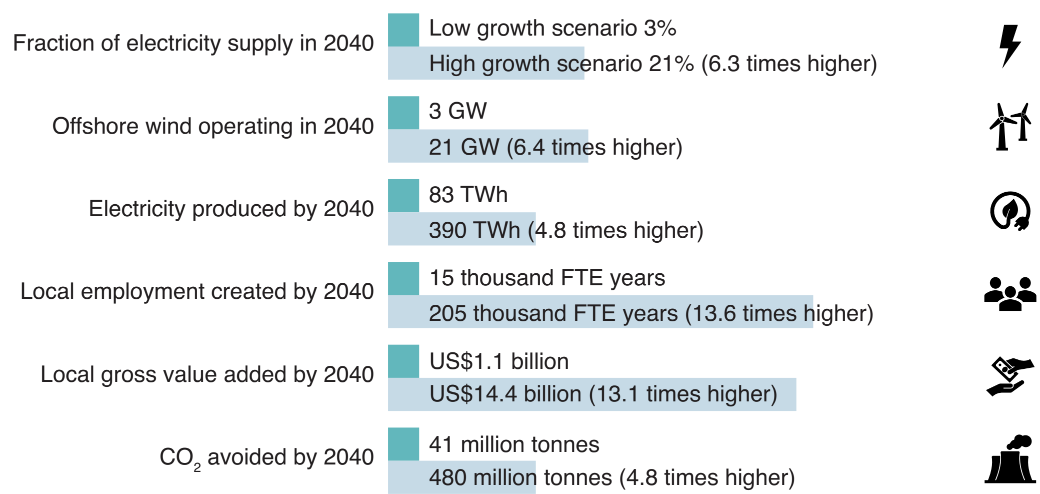
The analysis underpinning this roadmap is based on two possible growth scenarios for the Philippines' offshore wind industry. The purpose of these scenarios is not to set installation targets but rather to demonstrate and quantify the potential effect of industry scale on cost, E&S risks, and economic impact. The scenarios were not established (and have not been tested) through modelling of current or future energy systems and they do not consider least-cost planning.[ix]

The two development scenarios are summarized as follows:

- **Low growth**: Offshore wind supplies over 2 percent of the Philippines' electricity needs by 2040, reaching around 3 GW of installed GW of installed capacity.
- **High growth**: More than six times as much offshore wind installed, in which offshore wind supplies 14 percent of the Philippines' electricity needs by 2040, reaching over 20 GW of installed capacity.

The headline impacts of these two growth scenarios, considering the key metrics of electricity generation, cost, economic impact, and emissions, are summarized in Figure ES.2.

FIGURE ES.2 IMPACT OF OFFSHORE WIND IN THE PHILIPPINES UNDER LOW AND HIGH GROWTH SCENARIOS, 2020 TO 2040



Note: All figures are cumulative from 2020 to 2040. The fraction of electricity supply is discussed in Sections 3.2 and 4.2. Offshore wind capacity operating in 2040 is discussed in Section 2. Electricity produced is discussed in Sections 3.2 and 4.2. Local jobs and gross value added (GVA) are discussed in Sections 3.4, 4.4, and 12. CO_2 avoided is discussed in Section 7.1.

ix This considers the daily and seasonal patterns of generation and demand and the availability of other sources of renewable energy that are competitively priced. In markets with large areas of land with strong wind and solar resources, and few environmental and social impacts, onshore renewables projects at a scale of 100 MW or more, are likely to provide lower-cost electricity than offshore wind. In many offshore wind markets, these onshore impacts have tipped the balance toward offshore wind. At the time of writing, the World Bank is undertaking least-cost generation expansion analysis, considering temporal patterns.

Both growth scenarios could deliver substantial benefits to the Philippines; however, results indicate that the high growth scenario could deliver disproportionately larger economic benefits with a lower cost of energy. In comparison to a low growth scenario, high growth would result in the following:

- Faster cost reductions—32 percent lower LCOE for offshore wind electricity by 2040, caused by market scale, increased local capabilities, and quicker risk reduction.
- Over 13 times more local jobs and value added to the economy by 2040.

Provided that clear, long-term targets are set, the larger scale of the high growth scenario would lead to more investment in the local supply chain, thereby increasing the economic benefits and reducing costs. The effects of scale and market certainty have been experienced in established offshore wind markets where the increasing scale of deployment has meant that the industry generates substantial economic value and cost of energy has reduced to grid parity.

A consequence of higher growth is a higher risk of adverse E&S impacts. This places even greater importance to avoid areas of highest E&S sensitivity through proportionate marine spatial planning (MSP) and informed site selection. International financing for offshore wind depends on environmentally and socially sustainable sector development, in line with good international industry practice (GIIP)[x]. This includes implementing robust ESIA requirements and frameworks during the permitting processes and careful management and mitigation thereafter to manage risks. Ongoing stakeholder engagement with affected communities and nongovernmental organizations (NGOs) will form an important part of these MSP and ESIA processes.

A key prerequisite for a substantial contribution from offshore wind is a significantly upgraded electricity transmission network, which is also needed for a decarbonized energy system.

CHALLENGES FOR DEVELOPING OFFSHORE WIND

This roadmap demonstrates that offshore wind could deliver substantial value to the Philippines and help meet its decarbonization targets, but that there are many challenges in establishing a successful industry at a large scale. Some of the main challenges include

- **Cost of energy:** Purely on a cost of energy basis, offshore wind is more expensive than other forms of renewable energy. However, offshore wind could become competitive with the cost of conventional, thermal generation through large market-scale competition and innovation. This particularly applies to offshore floating wind technology, which is currently less commercially mature than fixed offshore technology. To catalyze the offshore wind market, a technology-specific auction would be required to avoid offshore wind directly competing with other renewables.
- **Transmission:** To connect projects at large scales sufficient to drive down the cost of energy, transmission grid upgrades and strengthening will be required to deliver power to demand centers. Some of the country's best offshore wind resource locations are far from major demand centers and therefore require lengthy new transmission lines. These will need to be delivered as part of a strategic, long-term, transmission development plan. In some limited cases, transmission may already be available to connect projects and could provide opportunities to deliver capacity in the short to medium term.

x GIIP, as defined by the IFC Performance Standard 3 (PS3), is the exercise of professional skill, diligence, prudence, and foresight that would reasonably be expected from skilled and experienced professionals engaged in the same type of undertaking under the same or similar circumstances, globally or regionally.

- **E&S impacts:** With increased scale, the risks of adverse E&S impacts increase, especially when cumulative impacts from multiple projects are considered. Data, stakeholder engagement, careful planning, and robust regulations will be required to manage this.
- **Limited local supply chain:** Despite the Philippines' strong industry, a comprehensive local supply chain will not be feasible in the short and medium term and many components will need to be imported. The size of the market will determine the imports; a larger market size will attract greater investment in the local supply chain and increase its capability.
- **Financing and bankability:** While the Philippines has experience in attracting large-scale, local and international financing for infrastructure projects, the unique and high risks associated with offshore wind will require careful risk management and mitigation measures to ensure bankability and minimize the cost of capital.
- **Project ownership:** Currently, no more than 40 percent of an offshore wind project can be owned by international parties, restricting the participation of experienced and financially sound project developers. Removing this restriction will allow the use of lower-cost international financing and, therefore, help reduce the cost of energy.

RECOMMENDED ACTIONS

This roadmap is the first step in developing a successful offshore wind industry in the Philippines and action will need to be taken by the Government of the Philippines to maximize the benefits that offshore wind can bring. To help focus efforts, the roadmap groups actions into priority themes, corresponding to immediate, near-term, and longer-term actions as groups for the government to consider (see Figure ES.3).

FIGURE ES.3 PRIORITY THEMES TO CREATE A SUCCESSFUL OFFSHORE WIND INDUSTRY IN THE PHILIPPINES

Source: World Bank, 2021.

From the analysis and findings of this roadmap study, the roadmap recommends 39 actions described in more detail in Section 5 of the report. Evidence for the basis of each recommended action is provided in the Supporting Information found within Sections 6 to 22. A summary of the recommended actions is as follows:

Vision and volume targets

1. The DOE publishes its vision for offshore wind to 2050 as part of a decarbonized energy mix for the Philippines, explaining how and why offshore wind is important.
2. The DOE sets offshore wind installed capacity targets for 2030 and 2040.
3. The DOE leads a holistic feasibility study for the Southern Mindoro potential offshore wind development zone—due to its high resource potential but complex and long lead time for development, this zone will need a strategic plan, particularly for transmission to enable its use for offshore wind projects.

Partnerships

4. The DOE establishes by circular a long-term official government-industry task force involving local and international project developers and key suppliers. The task force will help address this roadmap's recommendations and promote collaboration to ensure successful offshore industry growth.
5. The DOE signs a memorandum of agreement with relevant government departments, especially the Department of Environment and Natural Resources (DENR), to define interdepartmental cooperation on offshore wind, covering leasing, permitting, power purchase, transmission, health and safety, and key areas of delivery, including supply chain, ports, and finance.

Ownership

6. The DOE finds a way to resolve the restrictions of the 60 percent local ownership requirement of each offshore wind project (bringing offshore wind in line with other renewables technologies, such as biomass) or find alternative routes to address this barrier to investment in large projects.

Leasing, permitting, and power purchase

7. The DOE identifies offshore wind development zones through proportionate MSP, in line with GIIP, considering E&S factors (including cumulative impacts of multiple projects) and in conjunction with a long-term vision for transmission network development. This should include engagement with key stakeholders.
8. The DOE establishes offshore wind development zones, respecting existing WESCs and applications, guiding their use in prioritizing offshore wind development in the most advantageous areas, and minimizing negative E&S impacts.
9. The DOE issues guidance to developers about accepting requests to extend the predevelopment stage of a WESC beyond five years because of considerations outside the developer's control.

10. The DOE issues guidance about applying for a WESC for offshore wind adjacent to an existing WESC and explains to developers how to extend a WESC after the initial 25-year term if a project is still operating. The DOE should also confirm there is no requirement for payment of offshore occupation fee.
11. The DOE extends the Energy Virtual One-Stop Shop (EVOSS) to cover all relevant government departments to enable efficient and transparent permitting, including ESIA, in accordance with GIIP. It clarifies and streamlines the permitting process and provides supporting guidance to developers, regulators, and stakeholders, including clear timelines for permit decisions and prioritization of renewable energy projects.
12. The DOE reviews permit flexibility for project design to prevent the need for full reapplication and subsequent delays should any design changes be required as the project progresses. It makes sure supporting permitting processes guidance are available and appropriate for all parties.
13. The DOE establishes a competitive system solely for the procurement of offshore wind power offtake, with a ceiling price to limit cost to consumers, and considers a floor price in early years to avoid the risk of non-delivery due to lowball bids. Consultation on ceiling and floor prices should be conducted with stakeholders before competitions to reflect evolving fossil fuel and offshore wind prices, especially recognizing the current high fossil fuel and commodity prices.
14. The DOE develops a standard Power Purchase Agreement (PPA) across offshore wind projects to accelerate market development that provides stable income per megawatt-hour generated and may include indexation for foreign exchange rate variations. The implications of the choices for different terms and incentives should be studied to ensure the PPA will be attractive and bankable.
15. The DOE publishes a timetable for offshore wind power procurement competitions and coordinates across government and private sector organizations involved in administering competition to deliver.

Finance

16. The DOE explores how to ensure PPA counterparties (offtakers), and PPA terms remain viable as volumes of offshore wind contracted increase, including clarity on curtailment.
17. The Department of Finance promotes financial mechanisms to reduce cost of capital, including access to climate and other concessional finance, and ensures international market standards for contractual risk allocation, arbitration, and government backstop and an adequate security package for lenders.
18. The DOE supports the engagement of the local finance community with offshore wind, including communicating the E&S performance standards required to gain access to concessional and project financing.

Grid connection and transmission network

19. The DOE publishes the 2050 vision for a nationwide electricity transmission network for a decarbonized energy system, with milestone plans for 2030 and 2040 and financial consideration.
20. The DOE incorporates offshore wind development zones fully into Competitive Renewable Energy Zones (CREZ) processes and transmission development plan (TDP) processes.

21. The DOE, DENR, National Grid Corporation of the Philippines (NGCP), and Transmission Corporation (TransCo) undertake power system studies to understand the potential impacts of large-volume offshore wind on the future transmission network and ESIAs in line with GIIP and lender requirements to understand the E&S implications of transmission network upgrades, feeding these into MSP activities.

22. The DOE works with the NGCP and TransCo to update the TDP delivery, approval processes, and grid management practices to reflect the move to more supply from renewable energy sources.

23. The DOE considers possible low-cost solutions for investment in transmission system upgrades, such as concessional finance.

24. Once a grid connection agreement (GCA) is signed, the DOE ensures clarity and efficiency for projects in securing grid connections, including point-to-point applications and compensation for delayed grid connection availability.

Port infrastructure

25. The Philippines Ports Authority publishes an offshore wind ports prospectus, showing port capabilities against offshore wind physical requirements, and uses this to encourage dialogue and timely investment in relevant port facilities. This will involve engagement with independent government entities managing freeports.

26. The Philippines Ports Authority and the DOE work with ports to build a vision of how a pipeline of projects in the potential offshore wind development zones could be delivered in line with a strong government vision and to assess whether it is viable to establish any new port facilities. Planners should include E&S considerations and undertake a robust ESIA analysis for any potential developments.

27. The DOE, Department of Trade and Industry (DTI), National Economic and Development Authority (NEDA), Philippines Ports Authority, and relevant Freeport zone authorities explore potential local and inward investment to finance port upgrades or new facilities.[xi]

Understanding the marine environment

28. The DOE initiates or coordinates wind resource measurement to build confidence in available resource and extreme winds, recognizing typhoon risk.[xii]

29. The DOE, as part of a proportionate MSP process, initiates or coordinates other measurement and data gathering campaigns on key aspects of the zones including the following:

    - Metocean campaigns, especially wind speeds, and typical and extreme significant wave heights and currents
    - Geological surveys of the seabed and substrates
    - Ecological surveys to address any gaps in current knowledge of the zones
    - Social perceptions and potential impacts on local industries, such as fishing, shipping, aquaculture, and tourism.

xi It is important for the DOE to secure technical assistance to ensure that international good practice is followed to maximize shared understanding about the local marine environment.

xii It is important for the DOE to secure technical assistance with Recommendations 28 and 29 to ensure that international good practice is followed to maximize shared understanding about the local marine environment.

Supply chain development

30. The DOE and the DTI present a balanced vision for local supply chain development, encouraging international competition and enabling education and investment in local supply chain businesses, including training of onshore and offshore workers.

31. Learning from other offshore wind markets, the government avoids restrictive local content requirements that add risk and cost to projects and slows deployment.

Standards and regulations

32. The DENR reviews ESIA requirements for compatibility with international standards of GIIP, updates the legislative and policy framework, where necessary, and produces guidance for developers and stakeholders on the requirements and their relationship with the permitting and financing processes.

33. The DOE extends the Renewable Energy, Safety, Health and Environment Rules and Regulations (RESHERR) to cover health and safety for offshore wind and encourages focus on behavioral and cultural aspects of health and safety.

34. The DOE and Energy Regulatory Commission (ERC) consider amendments to the Philippines Grid Code and Distribution Codes to adjust to the significant increase in renewable power from offshore wind and other variable forms of renewable energy generation.

35. The DOE leads the creation of technical codes and regulations relevant to offshore wind, adopting international industry codes where appropriate.

Capacity building and gender equality

36. The DOE leads in helping government departments and other key stakeholders grow capacity and knowledge needed to process a growing volume of offshore wind projects.

37. The DOE involves developers and supply chain companies in gender equality working groups, supported by women's rights organizations in the Philippines, the Global Wind Energy Council (GWEC), and the Global Women's Network for the Energy Transition (GWNET).

38. The government and industry collaborate to collect and measure key data to ensure positive progress is being made to meet diversity targets.

39. The DOE considers introducing gender equality requirements into leasing and power purchase frameworks.

1. INTRODUCTION

This report is the output of a study commissioned by the World Bank Group (WBG) following an invitation from the Government of the Philippines to the WBG for assistance. It is part of a series of country roadmap studies supported by the WBG Offshore Wind (OSW) Development Program. The Program aims to accelerate the deployment of OSW in emerging markets and provide country governments with technical assistance to explore their OSW potential and develop a pipeline of bankable projects.

This roadmap was carried out with engagement and input from the Government of the Philippines and its relevant agencies, as well as stakeholders of the Philippines' and global OSW supply chains. See Section 22 for a list of stakeholders. The study outlines options for a successful OSW industry in the Philippines and supports collaboration between the Government of the Philippines and the offshore wind industry. This report does not represent the views of the Government of the Philippines.

This report is structured as follows:

- Section 2: Description of two scenarios for OSW in the Philippines used in the following sections of this study
- Sections 3 and 4: Short summaries of the outcomes of each of these two scenarios
- Section 5: Recommendations and roadmap for OSW in the Philippines

Supporting information

- Sections 6–8: Key ingredients for a successful wind industry, benefits and challenges of OSW, and market volume context in the Philippines
- Sections 9–22: Analysis covering all key aspects of the future of OSW in the Philippines

A report from the Biodiversity Consultancy, *The Philippines: Priority Biodiversity Values*, is provided as an Appendix.

Throughout the report, we refer to *Key Factors for Successful Development of Offshore Wind in Emerging Markets* (*Key Factors*).[4] It describes experiences in OSW markets to date, covering OSW as part of energy strategy, policy, frameworks, and delivery.

2. TWO SCENARIOS FOR OFFSHORE WIND IN THE PHILIPPINES

The Philippines has regionally important OSW resources. They are close to shore in both shallow and deep water, and some are near population centers. The country has an opportunity to use this resource to generate over 20 percent of its electricity by 2050,[i] (see Section 8), with the industry continuing to develop beyond this.

This report explores the impact of two possible OSW growth scenarios, chosen to cover realistic paths for the Philippines in the context of its future electricity needs, based on understanding from other emerging and established OSW markets. The purpose of the scenarios is to consider the quantifiable effect of industry scale on cost, consumer benefit, environmental and social (E&S) factors, economic benefit, and other aspects. The scenarios were not established (and have not been tested) through deep energy system modeling, which is recommended in due course. All other conditions are unchanged between the two scenarios, except that generation from OSW replaces more generation from fossil fuel energy sources, including coal.

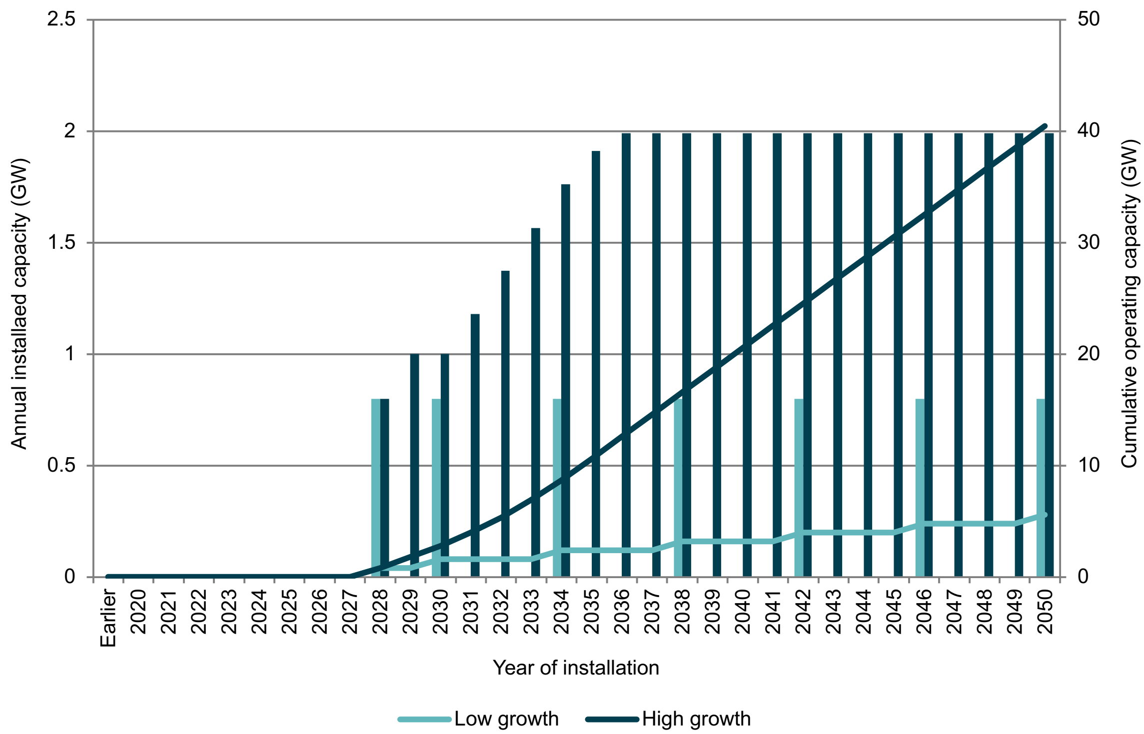
- *Low growth.* Compatible with wind element of the Department of Energy (DOE) National Renewable Energy Program (NREP).[5]
- *High growth.* Much larger, providing a major contribution to the energy supply as the Philippines moves to a decarbonized energy system around 2050, and sufficient to drive competition, local supply chain investment, and more cost reduction.

The differences between the scenarios are discussed in the following subsections.

i The detailed analysis in this roadmap covers up to 2040, not looking further due to increased uncertainty regarding cost reduction and technology scale beyond a 20-year horizon. In a number of cases, however, a vision to 2050 is discussed. This is because within this timescale, the energy systems of many countries will have been decarbonized, so it is important to keep a further horizon in mind.

2.1 VOLUMES AND TIMING

FIGURE 2.1 ANNUAL INSTALLED AND CUMULATIVE OPERATING CAPACITY IN THE TWO SCENARIOS IN THE PHILIPPINES, 2020–50

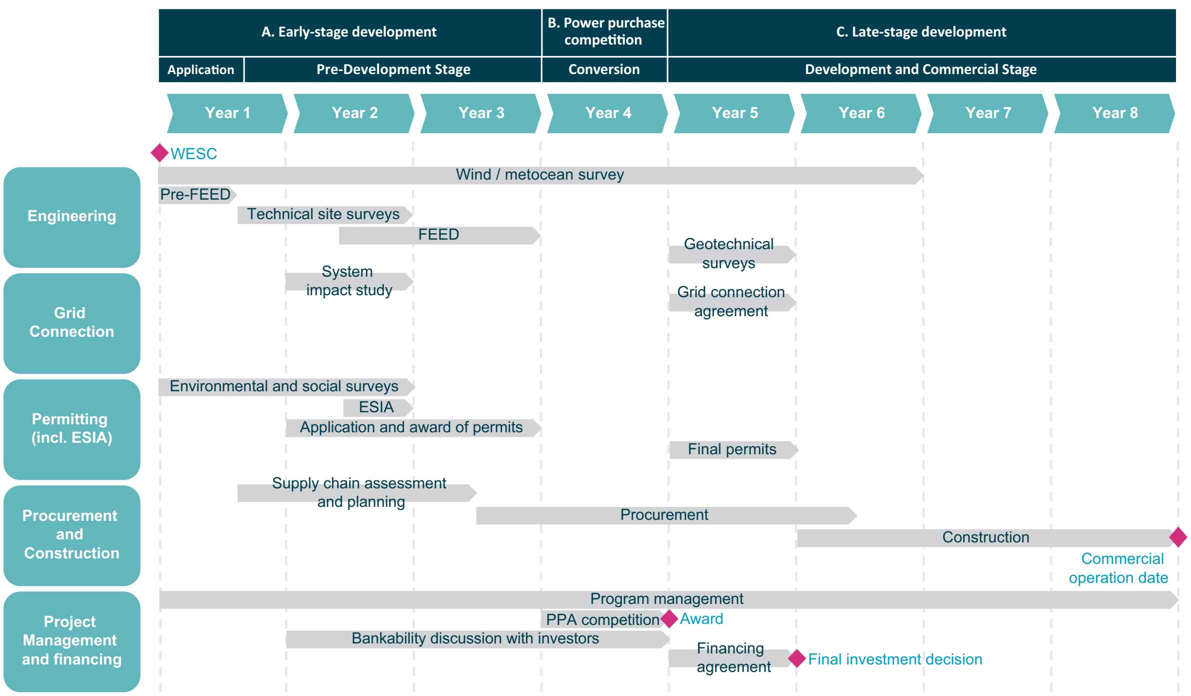


Source: BVG Associates.

Figure 2.1 shows the annual and cumulative installations for the two scenarios. The low growth scenario comprises seven large projects, spaced four years apart. In the high growth scenario, new capacity is installed each year, reaching an average installation rate of 2 gigawatts per year, consisting of two to three large projects, by the mid-2030s. Although the scenarios appear to show smooth trends in Figure 2.1, actual annual installation rates can be expected to vary due to project size and timing. Large projects are suggested because of the cost reduction benefits available at scale. Competitive auctions typically favor larger projects for this reason.

Experience from established markets is that offshore wind development timescales are significantly longer than for onshore wind and solar projects. Figure 2.2 shows an estimated program for a representative, early offshore wind project. In Philippines, the WESCs provide a 5-year pre-development stage (includes permitting, feasibility study, financial closing, and declaration of commerciality) and a 5-year development stage (includes construction and commissioning). Some projects received WESCs in 2019, so are required to be commissioned by 2029. The timing of the power purchase competition in Figure 2.2 could potentially occur earlier in the development process. Note that steps of the program and their order may vary from country to country with the power purchase agreement (PPA) award sometimes taken place, or recommended, after the ESIA completion. This would provide developers with power price certainty earlier in the development process, helping to manage risk of large development expenditure required. However, at an early program stage, the developer may not fully know the project design, which adds the risk of driving up project costs once revenue has been set. It has been learnt through established markets that the most informed competition takes place after design and permitting. DoE could explore the optimal timing of this through industry consultations.

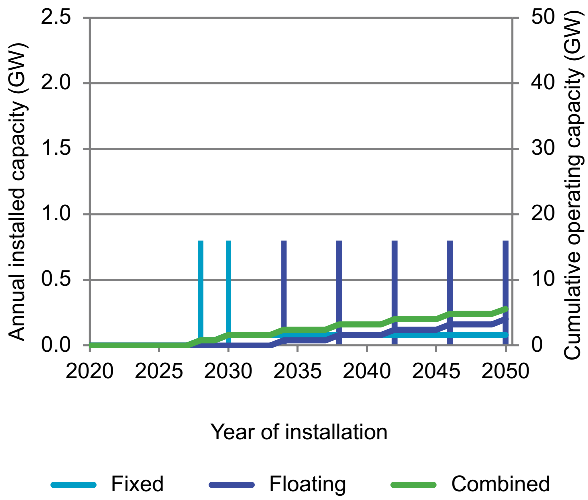
FIGURE 2.2 ESTIMATED PROGRAM FOR A REPRESENTATIVE, EARLY OFFSHORE WIND PROJECT IN ESTABLISHED MARKETS



Source: BVG Associates.
Note: ESIA = Environmental and social impact assessment; FEED = front-end engineering and design; WESC = wind energy service contracts.

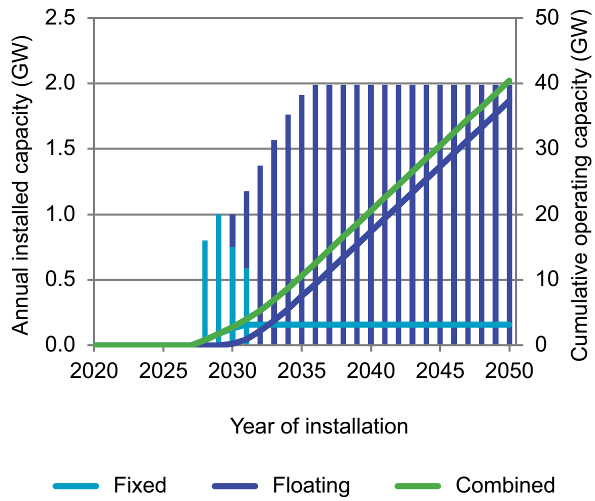
The split between fixed and floating activity is presented in Figure 2.3 and Figure 2.4. OSW development is expected to begin with fixed projects in shallow water (50 meters or shallower) because the levelized cost of energy (LCOE) of these projects will be lower (see Section 10). The Philippines has limited shallow water, so only a small volume of fixed OSW will be possible before the use of locations with less favorable resource will push the cost of generation from fixed sites higher than from that of floating sites. There are much larger areas of deeper water (50 meters or deeper). These have higher mean wind speeds that are well-suited to floating OSW projects, and development of floating projects is expected to occur after the initial fixed OSW projects and dominate in both scenarios. The transition between fixed and floating depends on project locations, progress with transmission network, and many other factors. Competitive processes should decide this transition to minimize cost.

FIGURE 2.3 LONG-TERM AMBITION IN LOW GROWTH SCENARIO IN THE PHILIPPINES, 2020–50



Source: BVG Associates.

FIGURE 2.4 LONG-TERM AMBITION IN HIGH GROWTH SCENARIO IN THE PHILIPPINES, 2020–50



Source: BVG Associates.

Figure 2.3 suggests first use of floating in the low growth scenario in 2034. Because fewer fixed sites will be used than in the high growth scenario, floating may be further delayed.

Figure 2.4 shows a first floating project in 2030 and last fixed project in 2031. Figure 10.2 compares technology costs for representative stated site conditions. Figure 10.2 still shows a significantly lower levelized cost of energy (LCOE) for fixed at around 2030, but the transition to floating may be affected by the lack of fixed sites with the wind resource stated.

Headline characteristics of the scenarios beyond volume are summarized in Table 2.1. Details of how to deliver these scenarios are covered in Section 5. The context for these scenarios within the Philippines' future electricity mix is in Section 8. The scenarios indicate how the OSW market could be built out. In reality, following our recommendations:

- The DOE will award leases in the form of wind energy service contracts (WESCs) (see Section 16).
- Authorities will grant permits (see Section 16).
- Power purchase contracts will be auctioned (see Section 17).

The installation rates, especially in early years, are dependent on the government's progress in establishing the policies and frameworks needed to enable OSW (see recommendations in Section 5), and the volume of projects progressing through these frameworks (see Section 6.2). The rates depend on government decisions on awards and auction caps and industry's appetite to take projects forward and ability to bid below the government's ceiling prices, which relates to industry cost reduction progressing at the pace anticipated. There are risks, especially that floating technology progresses slower because it is newer. Floating is expected to take over from fixed foundation between 2030 and 2035.

TABLE 2.1 CHARACTERISTICS OF TWO MARKET DEVELOPMENT SCENARIOS EXPLORED FOR THE PHILIPPINES, 2030, 2040, 2050

	Low Growth Scenario	High Growth Scenario
Cumulative operating capacity by end of (GW) **2030** **2040** **2050**	1.6 3.2 5.6	2.8 20.5 40.5
Maximum installation project rate (per year)	1 (0.8 GW)	3 (total of 2 GW)
Policy environment	• Good visibility of OSW installation target to 2040 • No formal local content requirement	• As with low growth scenario
Frameworks	• Improvements to leasing and permitting frameworks and bringing ESIA in line with GIIP • Continued competitive auctions for offtake agreements • Coordinated approach to transmission network upgrades • Improvements to framework for health and safety • Marine spatial planning as part of site selection	• As with low growth scenario, but faster progress and frameworks resourced to deliver higher volume of projects • MSP to define OSW development zones • Proactive work on significant transmission network upgrades to serve these zones • Improvements to framework to ensure timely grid connections for multiple projects • Improvements to frameworks for standards and certification
Supply chain	• Significant involvement of overseas project developers • Local project development and construction support services, offshore substation assembly, potential use of local tugs for floating turbine installation, operational phase services • Otherwise, mainly use suppliers active in the regional / global OSW market	• As with low growth scenario, with increased fraction of services supplied locally plus tower manufacture • Two-thirds of floating foundation manufacture • Suitable ports upgraded and available for OSW construction
Other prerequisites for scenario	• Engagement to smooth availability of sufficient volume of low-cost finance	• As with low growth scenario, but with increased importance due to volume of finance required (both for OSW projects and transmission network upgrades) • Strong three-way collaboration between government, Philippines' industry, and global OSW industry to proactively address barriers and opportunities and build confidence

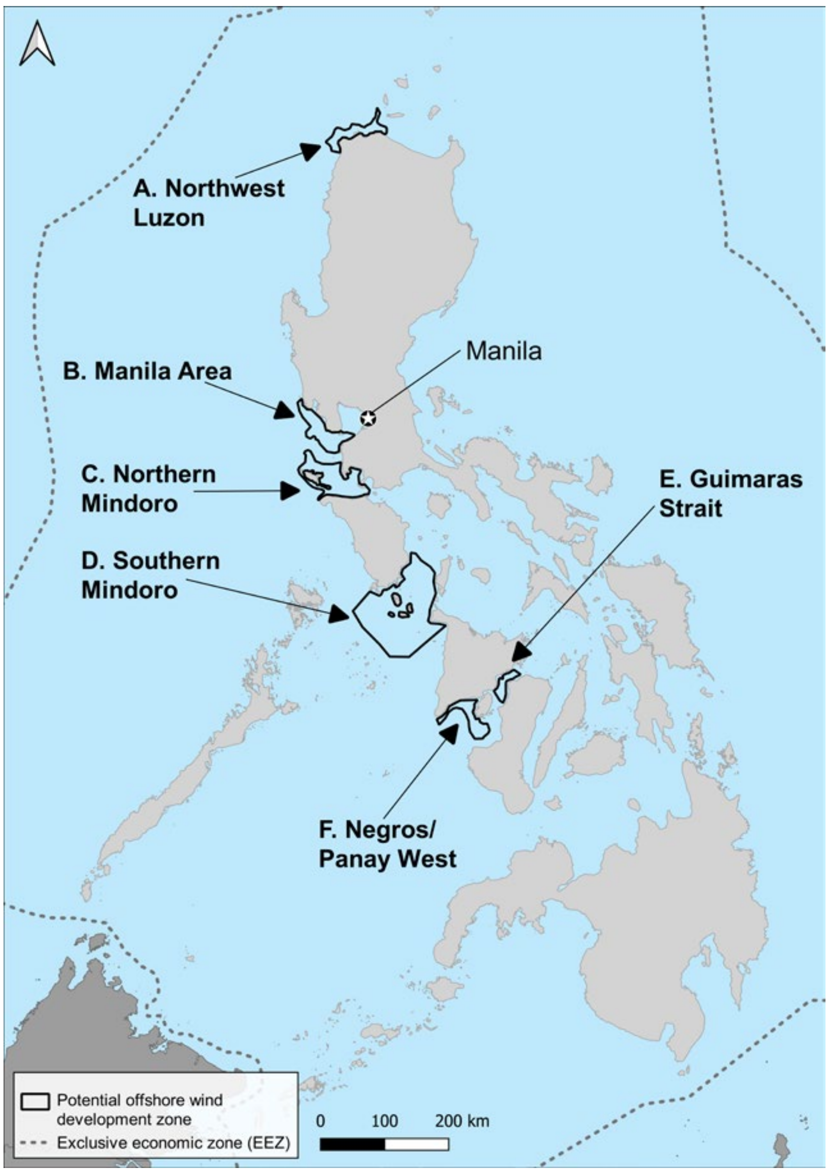
Source: BVG Associates

Note: ESIA = environmental and social impact assessment; GIIP = good international industry practice; MSP = marine spatial planning; OSW = offshore wind.

2.2 LOCATION OF OFFSHORE WIND PROJECTS

The Philippines has a vast coastline with a range of areas suitable for OSW development, and the government has received many WESC applications.[ii] Projects developed in the low growth scenario could obtain grid connections in existing transmission network upgrade processes, but in the high growth scenario, a much more strategic approach is required to enable efficient and timely investment in transmission network infrastructure. OSW projects need to be located strategically in the latter approach. Figure 2.5 presents potential OSW development zones (see analysis in Section 9). Defining zones is relevant to both scenarios but is essential for the timely delivery of the high growth scenario. Their introduction and use are further discussed in Section 9.

FIGURE 2.5 POTENTIAL OFFSHORE WIND DEVELOPMENT ZONES, THE PHILIPPINES



Source: BVG Associates.

ii As of March 2022, DOE had already awarded 30 Wind Energy Service Contracts with potential OSW capacity exceeding 21 GW.

3. LOW GROWTH SCENARIO

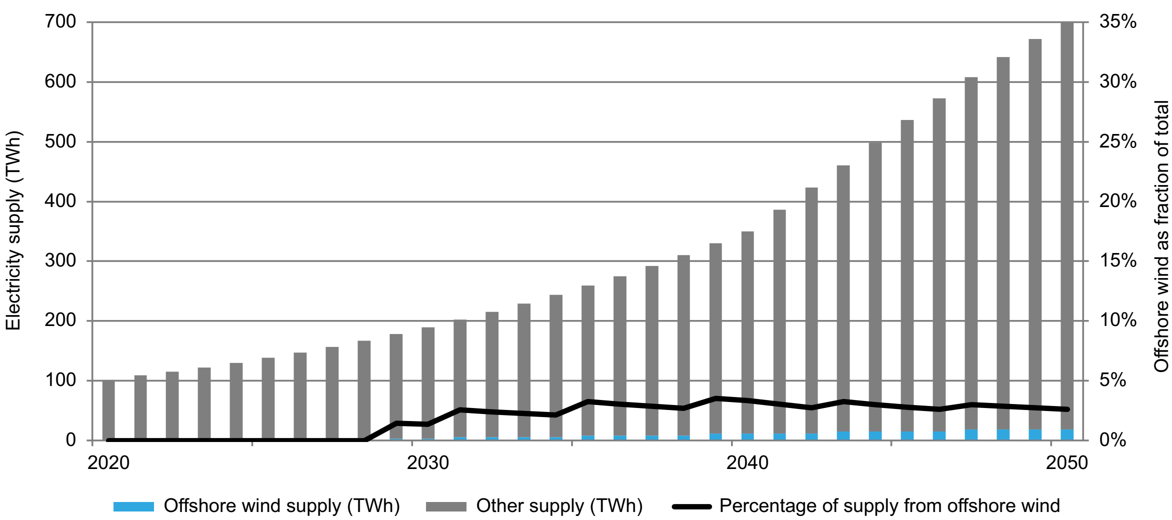
3.1 DEVELOPMENT AREAS

The low growth scenario involves two fixed OSW projects followed by five floating projects. There are enough wind energy service contracts (WESCs) signed or in application to deliver this volume, and most are in the OSW development zones shown in Figure 2.5.

3.2 ELECTRICITY MIX

Figure 3.1 shows OSW supply in the context of electricity demand from 2020 to 2050. Under the low growth scenario, OSW will provide about 3.3 percent of the Philippines' electricity supply in 2040, and this proportion drops slightly to 2050 (see Section 8.3). The total electricity supply does not vary between the low and high growth scenarios, but the proportion of electricity supplied from OSW is greater in the high growth scenario.

FIGURE 3.1 PROJECTED AMOUNT AND SHARE OF ELECTRICITY SUPPLIED BY OFFSHORE WIND AND OTHER SOURCES IN THE LOW GROWTH SCENARIO IN THE PHILIPPINES, 2020–50 LOW GROWTH SCENARIO



Source: Source: BVG Associates.

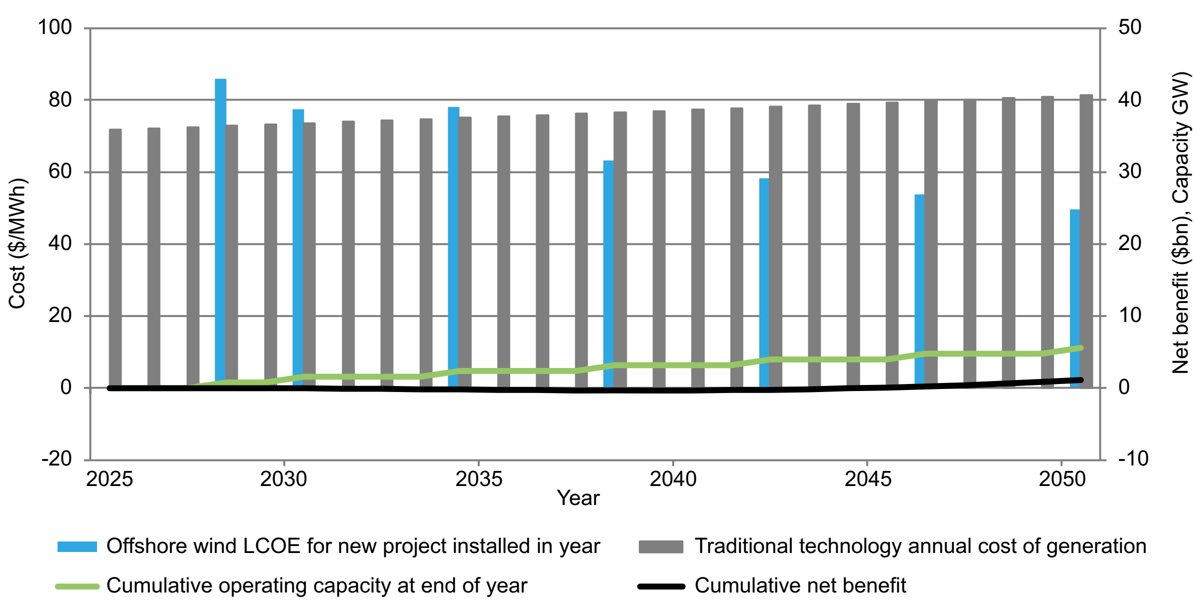
3.3 LEVELIZED COST OF ENERGY AND NET GENERATION COST BENEFIT

In the low growth scenario, the cost of energy reduces over time, reaching an estimate of US$77 per megawatt-hour for fixed projects in 2030 and US$61 per megawatt-hour for floating projects in 2040, by which time 83 terawatt-hours will have been generated. The reductions in cost of energy and the key drivers are discussed in Section 10, but include:

- Use of larger wind turbines
- Global learning about floating OSW technology, especially in foundation hull design and manufacture, and optimizing installation and operating logistics
- Reduction in cost of capital due to reduction in risk and availability of significant volumes of finance
- Growth in local and regional supply, learning and competition, driven by volume and market confidence

The net benefit to consumers by 2040 is minus US$0.3 billion (i.e. a net cost), rising to US$1.1 billion by 2050. In this scenario, generation costs are higher than generation from the indicative comparator (coal), ignoring all other considerations. An explanation of Figure 3.2, what is included in traditional technology and how net benefit is calculated, is in Section 7.1.

FIGURE 3.2 LCOE AND CUMULATIVE NET GENERATION COST BENEFIT OF OFFSHORE WIND COMPARED TO TRADITIONAL TECHNOLOGY IN THE LOW GROWTH SCENARIO IN THE PHILIPPINES, 2025–50



Source: BVG Associates.
Note: LCOE = levelized cost of energy.

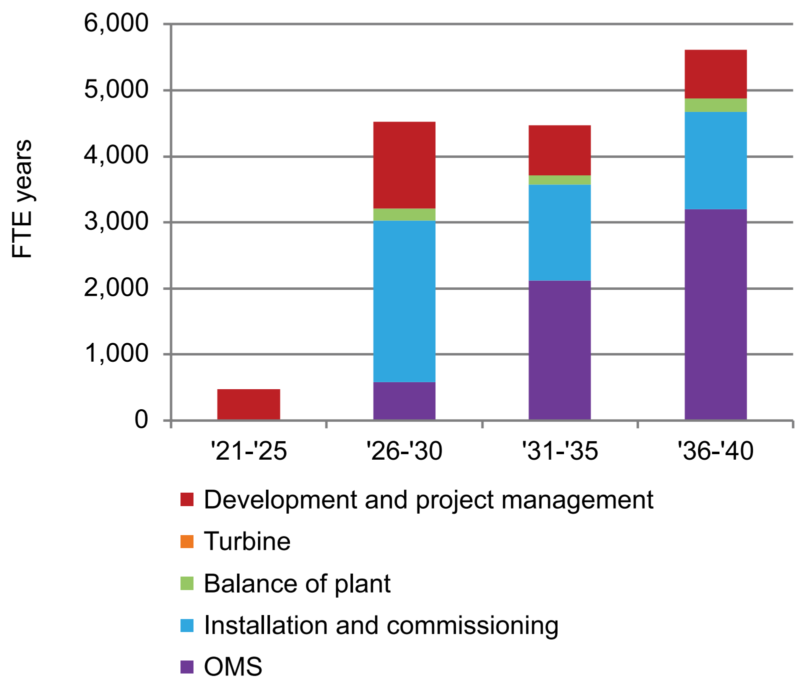
3.4 SUPPLY CHAIN AND ECONOMIC IMPACT

By 2040, the Philippines will have about 20 percent local content in its OSW farms (as derived in Section 12.3). It will supply onshore substation structures and some tug vessels for floating foundation installation, and provide development and OMS. Much of the local content and economic benefit will come from the installation and operational phase of projects. A coordinated multiagency approach will be required to maximize local benefits and grow local capabilities.

Jobs

Figure 3.3 shows that by 2040, the OSW industry will have created 15,000 full-time equivalent (FTE) years of employment.[iii] In the 2030s, annual local employment will be about 1,000 FTEs, on average. To compare these estimates with those in the high growth scenario, the same axis scale is used. Details of the supply chain, economic benefits of OSW, and supply chain investment needs are discussed in Sections 11 and 12, including a description of where and how the local content is broken down.

FIGURE 3.3 ESTIMATED NUMBER OF JOBS CREATED IN THE LOW GROWTH SCENARIO IN THE PHILIPPINES, 2021–40



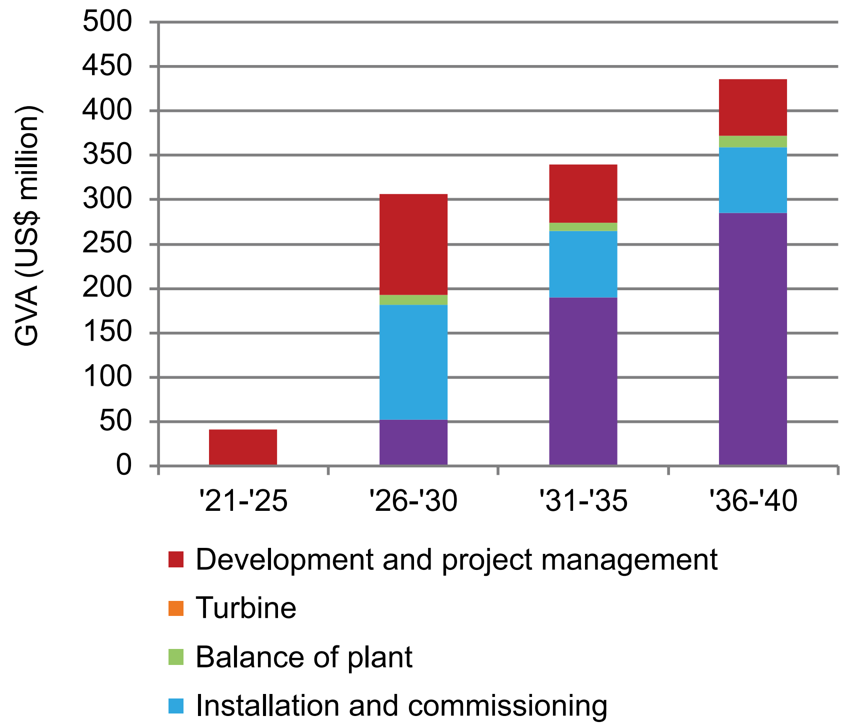
Source: BVG Associates.

iii Each FTE year of employment is the equivalent of one person working full time for a year. In reality the 11,000 FTE years of employment will be made up of some people working on the project for much less than a year and others working on the project for many years, especially during the operational phase. The employment profile for a typical project is shown in Figure 12.1.

Gross value added

Figure 3.4 shows that by 2040, supply to the OSW industry through local supply will add US$1.1 billion gross value. In the 2030s, annual gross value added (GVA) will be US$77 million, on average.

FIGURE 3.4 LOCAL GVA IN THE LOW GROWTH SCENARIO IN THE PHILIPPINES, 2021–40



Source: BVG Associates.

Supply chain investment

There is no expected large-scale investment in the supply chain in the low growth scenario.

3.5 TRANSMISSION AND PORT INFRASTRUCTURE

In this scenario, the electricity transmission system will benefit from ongoing upgrades defined in updates of the national Transmission Network Development Plan, including those relating to Competitive Renewable Energy Zones (CREZs). It is likely that installation of about 3 gigawatts of OSW, split evenly between fixed and floating, by 2040 would not drive significant upgrades beyond those already planned. The transmission system is discussed in Section 18.

With minimal local manufacturing, the delivery of four large projects up to 2040 will use only a small fraction of available port space. If a port is used only for one or two projects, then investment to upgrade the port is less likely and efficiency may be lower. Specific ports are discussed in Section 19.

3.6 ENVIRONMENTAL AND SOCIAL IMPACTS

By 2040, there will be about 150 large OSW turbines, installed in four large OSW projects, split between fixed (in the early years) and floating (later). Based on early assessments, E&S impacts are likely to be low or capable of being appropriately mitigated or compensated for through appropriate ongoing management measures as long as:

(a) proportionate marine spatial planning (MSP) approaches are used to ensure that projects are located carefully in the potential OSW development zones to avoid areas of high E&S sensitivity; and (b) robust, project-specific environmental and social impact assessments (ESIAs) are completed to good international industry practice (GIIP) and integrated into the permitting process. Key E&S considerations are discussed in Section 14.

Filipinos will benefit from reduced local pollution from coal plants, and the global environment will benefit from the displacement of 41 million metric tons of carbon dioxide (CO_2) by 2040. The Philippines is a signatory to the UNFCCC Paris Agreement and has a ratified unconditional target to reduce greenhouse gas emissions.[6, 7] Countries that remain heavily reliant on fossil fuels for electricity production are likely to come under increasing international pressure to decarbonize, as well pay more for electricity. Environmental metrics are discussed in Section 7.1.

Coastal communities may benefit through economic activity and jobs, although potential conflicts with fisheries, aquaculture, tourism, and other marine industries—and cultural heritage—will need to be considered and managed as part of MSP and ESIA. Residents of coastal communities, visitors, and tourists will be aware of the wind farms and their associated onshore infrastructure. The economic impact of these considerations has not been modeled at this stage.

People working on OSW farm construction and operations will be kept safe through a comprehensive approach to health and safety. We discuss this in Section 15.

3.7 FINANCE AND PROCUREMENT

In both scenarios, we propose OSW will be supported through competitive auctions. This structure will provide the best value to the Filipino economy. This is discussed in Section 17. Projects will be developed through international and local private developers.

To achieve this low growth scenario, the frameworks for leasing, ESIA, permitting, and PPAs will need some improvements, but no radical reform. These areas and relevant recommendations, including suggestions for next actions, are discussed in Sections 14, 16, and 17.

Capital expenditure (CAPEX) of about US$7.5 billion will be required for projects installed to the end of 2040. Sources of public finance will be accessed to fund projects and vital project infrastructure, including port upgrades and transmission assets. Financial instruments such as multilateral lending, credit enhancements, and the adoption of green standards can be used to attract international finance and reduce the cost of OSW. Access to finance is likely to be dependent on meeting lenders' performance standards, including those relating to E&S issues. Improvements to the ESIA and permitting process will be required to ensure that projects can meet these standards. This is discussed in Section 21.

3.8 ACTIONS TO DELIVER THE LOW GROWTH SCENARIO

Our recommendations for government actions are listed in Section 5. They are informed by the analysis of key ingredients of a successful OSW industry, discussed in Section 6.

3.9 SWOT ANALYSIS IN THE LOW GROWTH SCENARIO

A strengths, weaknesses, opportunities, and threats (SWOT) analysis for the Philippines adopting this scenario is presented in Table 3.1, comparing to low growth scenario to no OSW and the high growth scenario.

TABLE 3.1 SWOT ANALYSIS FOR THE PHILIPPINES IN THE LOW GROWTH SCENARIO FOR OSW DEVELOPMENT

Strengths	Weaknesses
• Delivers local, large-scale source of clean electricity supply, with long-term jobs and economic benefit • LCOE lower than traditional technology cost from the start • Going slower than in the high growth scenario enables more time to react as industry and technology changes • Less resource and urgency needed than in the high growth scenario on improving frameworks and addressing other challenges • Transmission system does not need significant upgrades beyond the types of upgrades already planned • Full MSP with OSW development zones, and various other actions are not needed • Proportionate spatial planning approaches should be used to ensure that projects are located carefully in potential OSW development zones to avoid areas of high E&S sensitivity	• Without high volumes of OSW, the Philippines has a larger clean energy gap to fill, without obvious large-scale alternatives • Market size will not sustain local manufacturing or export of any major components • The cost of energy is 23 percent higher than in high growth scenario and the cumulative net benefit is nine times lower, for 4.8 times lower volume of electricity by 2040 • Delivers 13 times fewer jobs and GVA compared to the high growth scenario, by 2040 • Much work on frameworks and industry building is still required, but for lower benefit • Current ESIA processes do not fully follow GIIP or conform to E&S performance standards mandated by international lenders
Opportunities	**Threats**
• Can accelerate at any time, though with some delay to faster acceleration due to project development timescales • Some local supply chain development and job creation	• All government preparatory work on policy and frameworks has a fiscal impact, with payback only if the industry progresses as planned • In the absence of clear government guidance and standards for ESIA aligned with GIIP and lender requirements, poor siting and development of projects could lead to adverse E&S effects, delays in financing projects, and damage reputation of the industry, slowing inward investment opportunities and future growth prospects • Poorly considered transmission network constraints could slow OSW • Key players may never enter the market, further reducing competition and increasing cost

Source: BVG Associates.
Note: E&S = environmental and social; ESIA = environmental and social impact assessment; GIIP = good international industry practice; GVA = gross value added; LCOE = levelized cost of energy; MSP = marine spatial planning; OSW = offshore wind.

4. HIGH GROWTH SCENARIO

Compared to the low growth scenario, high growth delivers more energy, more jobs, lower net cumulative cost, faster payback, and more CO_2 avoided. All measures improve because of the increased cost reduction delivered by a larger market, but government has to make a greater commitment and take more urgent action.

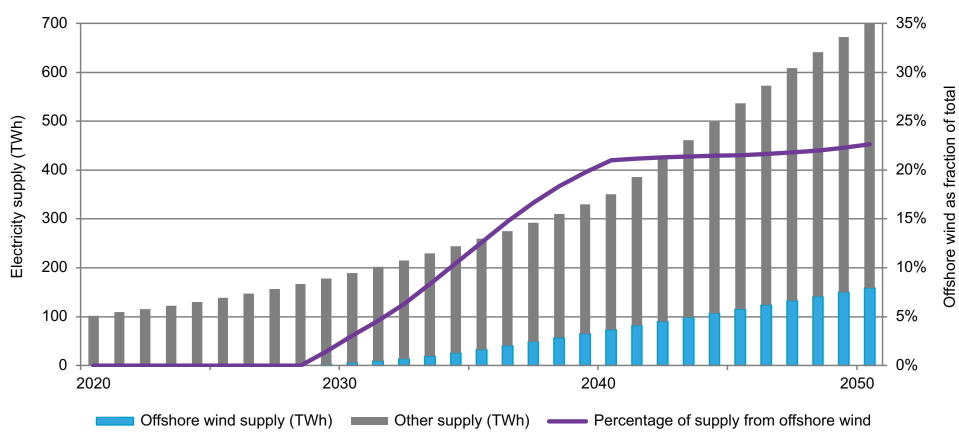
4.1 DEVELOPMENT AREAS

The high growth scenario involves mainly floating OSW projects, following four years of fixed projects in the lowest-cost sites. As the cost of floating OSW reduces and because of the low availability of locations suitable for fixed projects, the market will transition to almost exclusively floating projects. Under the high growth scenario, there will be slightly more than 20 gigawatts of OSW projects by 2040, 17 gigawatts of which will be floating. These projects will cover about 19 percent of the potential OSW development zones identified in Figure 2.5, more than six times as much as in the low growth scenario. Depending on the results of MSP and energy planning for beyond 2040, other OSW development zones may be established to preserve competition between sites. As the drivers of levelized cost of electricity (LCOE) change and the understanding of E&S considerations evolve, other areas may be included.

4.2 ELECTRICITY MIX

Figure 4.1 shows supply from OSW as part of demand for electricity from 2020 to 2050. In 2040, OSW will provide 21 percent of the Philippines' electricity supply. By 2050, this increases marginally, reaching 23 percent, or about two-thirds of that anticipated for Europe, and nine times that in the low growth scenario (see Section 8.3).

FIGURE 4.1 PROJECTED SHARE AND AMOUNT OF ELECTRICITY SUPPLIED BY OFFSHORE WIND AND OTHER SOURCES IN HIGH GROWTH SCENARIO IN THE PHILIPPINES, 2020–50

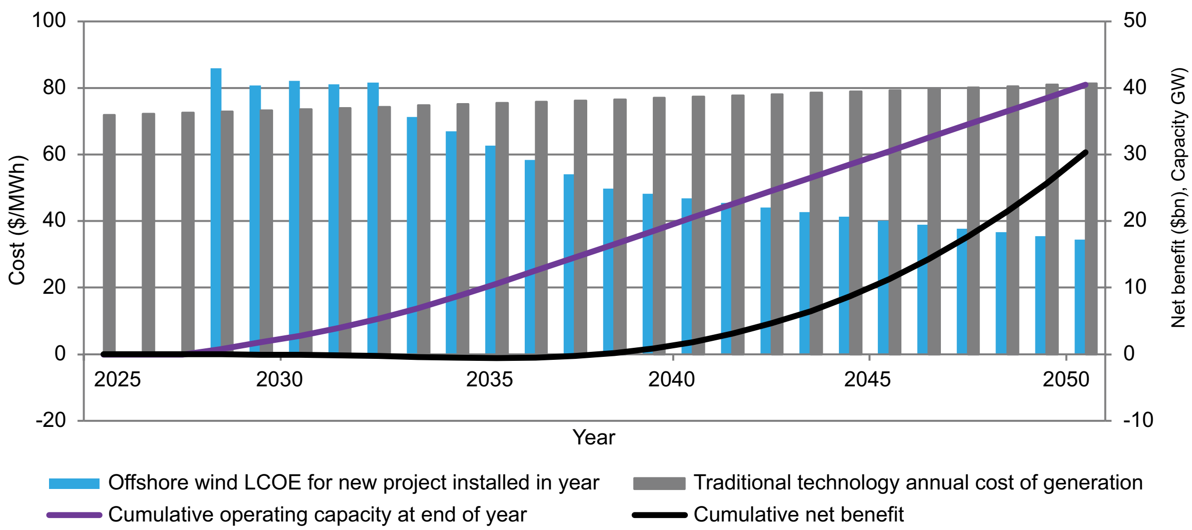


Source: BVG Associates.

4.3 LEVELIZED COST OF ENERGY AND NET GENERATION COST BENEFIT

In the high growth scenario, the cost of energy reduces over time, reaching an estimated US$76 per megawatt-hour for fixed projects in 2030 and US$47 per megawatt-hour for floating projects in 2040, by which time an estimated 393 terawatt-hours will have been generated. The 20 percent lower LCOE than in the low growth scenario is due to (a) faster reduction of the initial costs of starting in a new market; and (b) lower weighted average cost of capital (WACC) from the expectation of more foreign investment and reduced risk under the high growth scenario. See Section 6.6 and Section 10.

FIGURE 4.2 LCOE AND CUMULATIVE NET GENERATION COST BENEFIT OF OFFSHORE WIND COMPARED TO TRADITIONAL TECHNOLOGY IN HIGH GROWTH SCENARIO IN THE PHILIPPINES, 2025–50



Source: BVG Associates.
Note: LCOE = levelized cost of energy.

The net benefit to consumers by 2040 is US$1.9 billion, rising to US$30 billion by 2050, 28 times higher than in the low growth scenario. An explanation of Figure 4.2 and how net benefit is calculated is provided in Section 7.1.

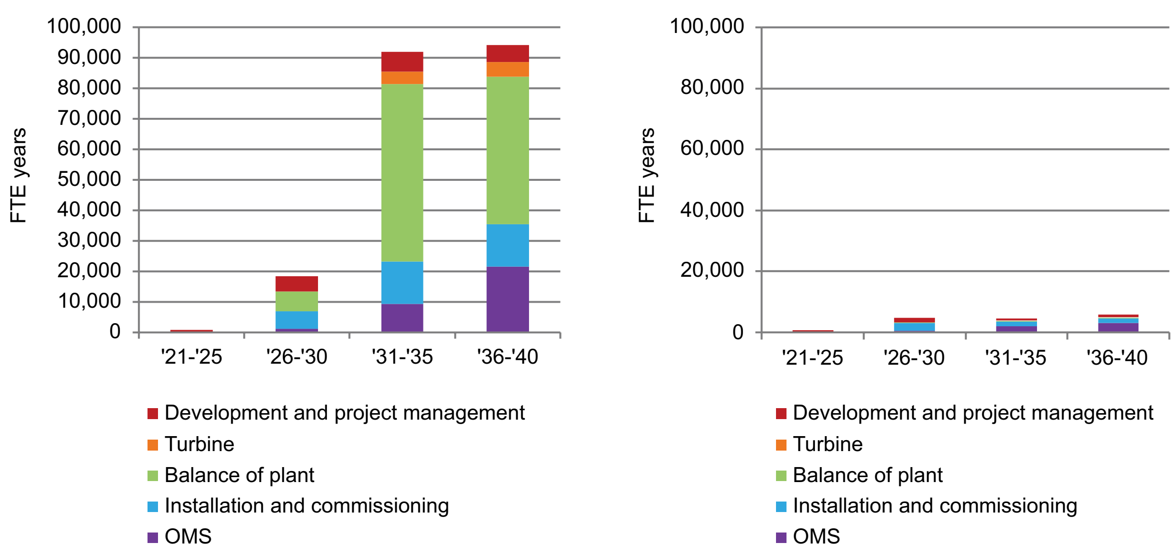
4.4 SUPPLY CHAIN AND ECONOMIC IMPACT

By 2040, the Philippines will have about 35 percent local content in its OSW farms (see Section 12.3). It will be supplying towers, floating foundations, offshore substation foundations and topsides, onshore substation structures, and some tug vessels for floating foundation installation, and providing development and OMS. In the high growth scenario, the Philippines could export turbine towers to nearby markets. Increased market size has a significant impact on local economic benefit, as discussed in Section 6.6. Details of the supply chain, economic benefits of OSW, and supply chain investment needs, including a description of local content, are discussed in Sections 11 and 12.

Jobs

Figure 4.3, panels a and b, shows that by 2040, the OSW industry will have created 205,000 FTE years of employment, which is 13 times as much as in the low growth scenario. This is because 6.4 times the volume is installed and 2.2 times as many local jobs are created per megawatt installed due to more local supply. In addition, 3,000 FTE years will have been created between 2031 and 2040 through the export of towers manufactured in the Philippines. In the 2030s, annual local employment will be about 17,000 FTEs, on average.

FIGURE 4.3 PROJECTED NUMBER OF OSW-RELATED JOBS CREATED IN HIGH AND LOW GROWTH SCENARIOS IN THE PHILIPPINES, 2021–40

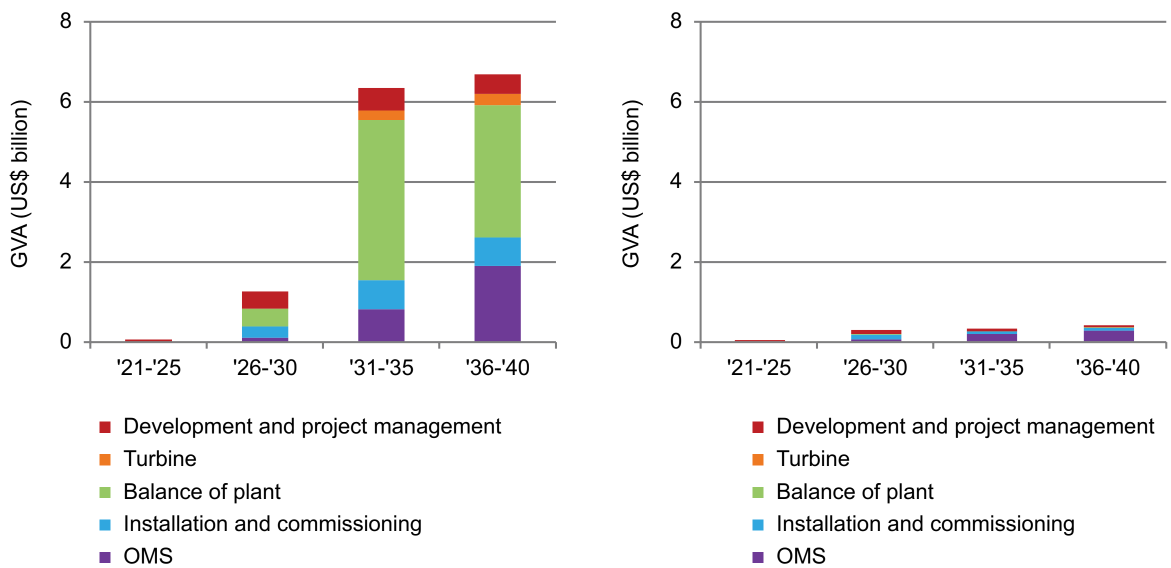


Source: BVG Associates.
Note: High growth scenario under the graph on the left and aligned with its Y axis
Note: Low growth scenario under the graph on the right and aligned with its Y axis

Gross value added

Figure 4.4 shows that by 2040, supply to the OSW industry will add US$14 billion of gross value, which is 13 times as much as in the low growth scenario. In addition, the export of towers manufactured in the Philippines will create US$255 million of gross value between 2031 and 2040. During the 2030s, annual GVA will exceed US$1.2 billion, on average.

FIGURE 4.4 PROJECTED LOCAL GVA IN HIGH AND LOW GROWTH SCENARIOS IN THE PHILIPPINES, 2021–40



Source: BVG Associates.
Note: High growth scenario under the graph on the left and aligned with its Y axis
Note: Low growth scenario under the graph on the right and aligned with its Y axis

Supply chain investment

Large-scale investment in the supply chain will be used to establish local manufacture of towers and floating foundations. This investment in new or upgraded facilities and tooling could amount to US$80 million to US$250 million, with most investment likely happening around 2030.

4.5 TRANSMISSION AND PORT INFRASTRUCTURE

In this scenario, the electricity transmission system will need significant reinforcement, beyond ongoing revisions typical of the national Transmission Network Development Plan. Strong links are proposed, including eventually connecting a western link through Mindoro to Manila. Such links will be important as the country moves to higher levels of electrification and decarbonization of transport, heat, and electricity. This transformation will require significant vision, finance, and time to deliver. For OSW to reach its potential, upgrades are needed that cannot be implemented on a project-by-project basis. Therefore, we propose a strategic approach to OSW development zones and the transmission network (see Section 18).

At an annual installation rate of 2 gigawatts per year, three to four ports will be in use for OSW construction at any one time, and volumes will enable investment. It is unlikely that any new ports will be established, but delivering the full 10–30 gigawatts of the potential Southern Mindoro OSW development zone might warrant such investment, and other significant users may benefit. Ports are discussed in Section 19.

4.6 ENVIRONMENTAL AND SOCIAL IMPACTS

By 2040, there will be about 1,000 large OSW turbines in the Philippines, installed in projects over at least six OSW development zones. Eighty-five percent of these will be floating in deep water. If not carefully planned and permitted, this high level of development could lead to significant adverse E&S effects, including on internationally important biodiversity. Comprehensive MSP will be required to ensure that projects are located carefully in the potential OSW development zones. Robust, project-specific ESIA that achieve the standard of GIIP and are integrated into the permitting process will be required to secure appropriate ongoing mitigation and management of impacts. It will not be possible to completely avoid adverse E&S impact. Government officials, developers, financiers, and stakeholders need to consider the trade-offs between securing reliable low-carbon power and these adverse effects. Key E&S considerations are discussed in Section 14.

Filipinos will benefit from reduced local pollution from coal plants, and the global environment will benefit from the displacement of 197 million metric tons of CO_2 avoided by 2040, five times that of the low scenario. This and other environmental metrics are discussed in Section 7.1.

People working on OSW farm construction and operations will be kept safe from harm through a comprehensive approach to health and safety. We discuss this in Section 15.

Coastal communities may benefit more in the high growth than in the low growth scenario from the projects in terms of economic activity and jobs, as discussed in Section 4.4; however, adverse impacts on industries such as fishing, aquaculture, and tourism, as well as damage to cultural heritage, may arise. The simplified economic analysis provided in the roadmap covers jobs and GVA from OSW and net consumer benefit relating to cost of production only. In time, more effects (including those discussed here) can be assessed through more detailed sectoral and economic analysis.

4.7 FINANCE AND PROCUREMENT

As in the low growth scenario, OSW will be supported through competitive auctions. This structure will provide the best value to the economy (see Section 17). Policy makers will need to strengthen frameworks for leasing, MSP, ESIA, permitting, and power purchase agreements (PPAs). Organizations administering frameworks and acting as consultees will need strengthening and a significant increase in capacity. Significant governance and administrative reforms may be required to deliver this level of capacity (see Sections 14, 16, and 17 and relevant recommendations, including suggestions for next actions).

Standards and processes that do not meet GIIP will limit the availability of international finance, particularly in E&S impact assessment and stakeholder engagement. There is more urgency to progress these than in the low growth scenario. These areas are discussed in Section 21.

A capital expenditure (CAPEX) of about $US50 billion will be required for projects installed to the end of 2040. As in the low growth scenario, sources of public finance will be accessed to fund projects and vital project infrastructure, including port upgrades and transmission assets. Access to finance is likely to be dependent on meeting lenders' performance standards, including those relating to E&S issues. Improvements to the ESIA and permitting process will ensure that projects can meet these standards (see Section 21).

4.8 ACTIONS TO DELIVER THE HIGH GROWTH SCENARIO

Our recommendations for government actions are listed in Section 5. They are informed by the analysis of key ingredients of a successful OSW industry, discussed in Section 6. Due to the greater scale and faster pace of industry growth in this scenario, compared to the low growth scenario, there is increased commitment needed and urgency for government action.

4.9 SWOT ANALYSIS FOR THE PHILIPPINES IN THE HIGH GROWTH SCENARIO

Table 4.1 presents a SWOT analysis for the Philippines adopting the high growth scenario, comparing to no OSW and the low growth scenario.

TABLE 4.1 SWOT ANALYSIS FOR THE PHILIPPINES IN THE HIGH GROWTH SCENARIO FOR OSW DEVELOPMENT

Strengths	**Weaknesses**
• Delivers local, large-scale source of clean electricity supply, with long-term jobs and economic benefit • LCOE lower than traditional technology cost from the start • Drives innovation and supply chain investment much more than low growth scenario • Larger market size will sustain local competition and support exports, delivering 13 times more jobs and GVA compared to the low growth scenario, by 2040 • The cost of energy is 18 percent lower than in low growth scenario and the cumulative net benefit is nine times higher, for 4.8 times high volume of electricity by 2040 • Displaces 4.8 times more CO_2 compared to coal than the low growth scenario, with climate benefits scaled similarly	• Transmission network needs extensive reinforcement, which will require significant vision, finance, and time • Requires greater commitment across government and more urgent action than in the low growth scenario • Needs significant increase in capacity in organizations administering frameworks than in the low growth scenario • Current ESIA processes do not fully follow GIIP or conform to E&S performance standards mandated by international lenders
Opportunities	**Threats**
• Local manufacturing of towers and floating foundations • Export potential of towers to East or Southeast Asia	• All government preparatory work on policy and frameworks has a fiscal impact, with payback only if the industry progresses as planned • More prep work is needed sooner than in the low growth scenario • Lack of cross-government support could increase risk • Delays to upgrading transmission network could delay projects and lead to loss of investor confidence • Higher number of turbines installed than in the low growth scenario could lead to significant adverse E&S impacts, including on internationally important biodiversity, if not carefully planned (via proportionate MSP), assessed (including via robust ESIA), permitted and managed (in some cases via implementing mitigation) • Trade-offs between clean energy production and other E&S harm are more likely to be required than in the low growth scenario, which will necessitate careful management and stakeholder engagement • In the absence of clear government guidance and standards for ESIA aligned with GIIP and lender requirements, poor siting and development of projects could lead to adverse E&S effects, delays in financing projects, and damage the reputation of the industry, slowing inward investment opportunities and future growth prospects

Source: BVG Associates.
Note: E&S = environmental and social; ESIA = environmental and social impact assessment; GIIP = good international industry practice; GVA = gross value added; LCOE = levelized cost of energy; OSW = offshore wind.

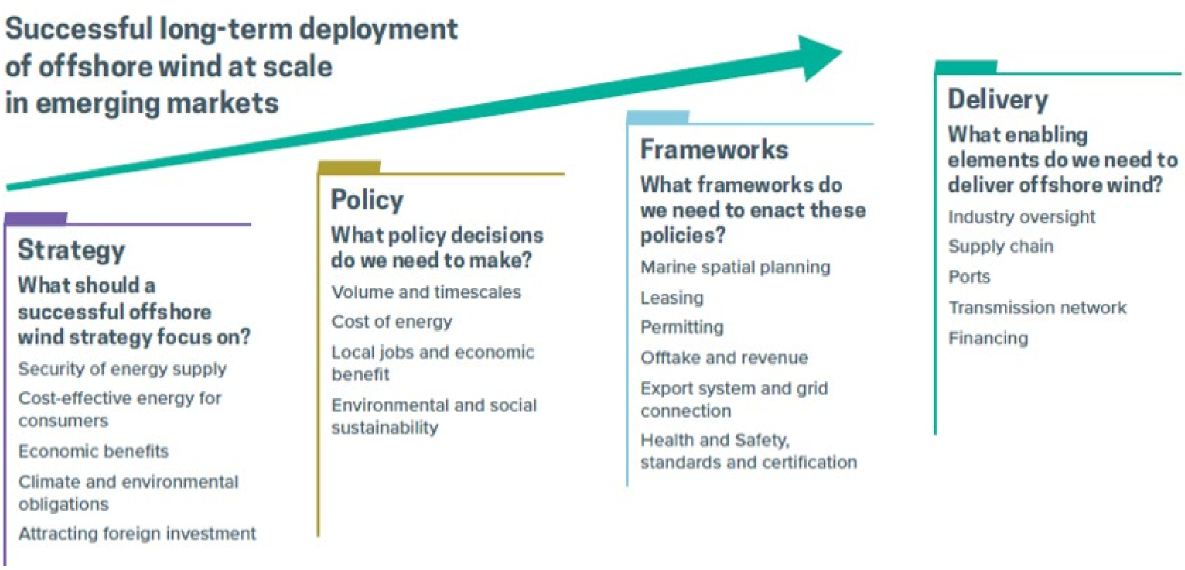
5. RECOMMENDATIONS IN ROADMAP FOR OFFSHORE WIND IN THE PHILIPPINES

OSW has seen tremendous growth in some parts of the world, most notably in northwest Europe and China. Governments recognize that if they provide a stable and attractive policy and regulatory framework, looking at least 10 years ahead, then developers can deliver OSW farms that provide low-cost and carbon-free electricity to power their economies.

OSW has been a success in markets like the UK, Germany, Denmark, and the Netherlands, because successive governments have implemented and sustained strategic policies and frameworks that encourage the development of OSW farms by private developers and investors. Frameworks set out robust, transparent, and timely processes for seabed leasing and project permitting.

Governments have used MSP processes to balance the needs of multiple stakeholders and environmental constraints. In parallel, they have considered what investment in grid and other infrastructure will be required to deliver a sustainable pipeline of projects. Finally, they make sure projects are financeable and can attract competitive capital by offering a stable and attractive route to market for the electricity generated. Based on country-specific experience, Section 6 summarizes key ingredients for a successful OSW industry, taking much learning from World Bank Group's *Key Factors* report.[4] Key questions and topics that report addresses are summarized in Figure 5.1.

FIGURE 5.1 STRATEGY, POLICY, FRAMEWORKS, AND DELIVERY: FOUR KEY PILLARS FOR SUCCESSFUL OFFSHORE WIND DEVELOPMENT



Source: World Bank, 2021[4]

Key recommendations in the roadmap for OSW are presented in Sections 5.2 to 5.12. Figure 5.3 and Figure 5.4 summarize the two scenarios and suggest somewhat differing timing of activities for each scenario. The timing enables delivery of early projects in 2028 and establishes a pipeline of projects to deliver the volumes shown in the scenarios. The first WESCs were signed in late 2019 and 2020 and, although these allow a period of up to 10 years for project commissioning, the pace of industry progress indicates momentum to move forward as quickly as reasonable. Therefore, the timing proposed assumes the usual project development program of about 8 years of duration to be commissioned. There is a risk that industry confidence might lessen if early projects progress more slowly. It is however recognized that delays may be experienced if industry cost reductions do not progress at the pace anticipated. This particularly applies to floating technology, which is currently less technologically and commercially mature than fixed OSW.

The roadmap timelines in Figure 5.3 and Figure 5.4 are based on the principle of delivering the first projects as early as practically possible. The timelines represent the best-case scenario, based on a prompt and committed start by the government. Critical factors that could impact the suggested timeline include:

- The effort required by the government to develop a policies and frameworks for OSW and build confidence in those frameworks with stakeholders and industry
- The requirement for improved data to inform spatial planning, and ESIA
- The requirement to plan, finance, and build transmission network (and potentially port) infrastructure in time for the planned OSW capacity
- OSW industry progress in developing technology and supply chain, especially relating to floating OSW

To maximize the opportunity of delivering the roadmap to this timetable, the government should manage and mitigate these critical factors.

5.1 JUSTIFICATION FOR OUR KEY ROADMAP RECOMMENDATIONS

Our recommendations are based on robust analysis, consultation, and experience. Our justification for key roadmap recommendations is provided below. We are grateful for the consultation feedback that was overwhelmingly positive and that contained many useful additions, which have been incorporated.

Evolution of frameworks, rather than major changes

There is already a strong basis for OSW development in many areas, and introducing major changes risks slowing activity and damaging industry confidence. We recommend keeping the two-stage process of awarding leases and power purchase agreements (PPAs) and an industry-led approach to project development, rather than transferring early project development to the government.

Another key reason not to recommend significant change is that OSW has not yet delivered. Until it has, there will be little political appetite to implement time-consuming changes and insufficient understanding to define and implement changes well. It will be vital, however, that the government and national industry and global wind industry players work together to address necessary frameworks. A summary of our assessment of key conditions for OSW in the Philippines is provided in Table 5.1.

TABLE 5.1 SUMMARY OF ASSESSMENT OF KEY CONDITIONS FOR OSW IN THE PHILIPPINES

Condition	Assessment
Wind resource	Good, especially where floating
Demand for clean power	High to 2040 and beyond
Leasing framework	Needs some change
Permitting framework	Needs some change
Power purchase framework	Needs some change
Grid connection framework	Needs some change
Health and safety framework	Needs some change
Transmission network	Clear vision and significant upgrades required over time
Cost of energy	Industry likely to need to focus hard on cost reduction to meet proposed ceiling price
Local supply chain	Relatively weak but OK to use regional / global supply chain
Rights to ownership	Limits to foreign ownership will limit OSW deployment and are not compatible with rights in many other areas of the power sector

Source: BVG Associates.

Need for comparable LCOE with other large-scale generation projects

OSW has much to offer the Philippines as it moves to a decarbonized energy system, at a volume greater than likely to be delivered from onshore wind and solar. The government, however, has a strong drive to deliver affordable power to consumers, meaning that early OSW project are not likely to compete head-to-head with onshore renewables.

For OSW to have its own auction, we believe the industry needs to show costs competitive with other forms of large-scale generation, such as coal (even recognizing the moratorium). When looking at early projects in today's emerging markets, the levelized cost of energy (LCOE) trajectory might seem overly aggressive for some and reasonable for others[iv].

We recommend starting with large projects (for fixed and floating OSW), which requires facilitating access to the global OSW supply chain and creating the conditions for competitive supply of finance. The experience gained in emerging and established markets can be applied to future projects in the Philippines, and ways to avoid some of the early "teething trouble" in emerging markets will have been learned.

Although earlier markets started with small projects, this was in part due to the state of the technology globally available. OSW technology installed in multi-gigawatt projects is now available, and many international developers and suppliers are experienced in large project delivery. This pool of expertise will have grown significantly by the time first projects are installed in the Philippines in around 2028.

We suggest there be an LCOE that can be translated into an auction ceiling price for projects completed eight years from now. This will give project developers and their supply chains time to be creative in delivering. We believe that the can-do attitude of the global wind industry, the positive spirit

iv Traditional technology fuel price inflation and other carbon abatement measures are approximate, set to US$70/MWh in 2020 (lower than recent coal auction prices), with an inflator of 0.5% per year. Note that as of March 2022, coal prices are at historical highs and thus, $70/MWh does not reflect recent pricing shifts with electricity generation from coal becoming significantly more expensive, at least in the shorter term.

of the people of the Philippines, and ongoing trends in cost reduction in all OSW markets mean there is an excellent chance of delivering. If industry is slow in reducing cost in emerging markets (already at below US$50 per megawatt-hour in some established markets), then this may delay the market in the Philippines by a short period.

Timescales for industry growth

We recognize that some want OSW to be deployed faster than suggested. While this would be beneficial, our experience is that establishing robust and bankable frameworks is key, and large, nationally relevant infrastructure projects take a long time, even in established OSW markets. We also believe the timescales fit with reasonable expectations of progress regarding transmission network upgrades, so that there will not be a gap between early projects (that do not drive significant upgrades to receive a grid connection) and subsequent projects that do.

Foreign ownership

Foreign ownership is seen by many in industry as essential in facilitating the vast investment needed to deliver OSW projects, much larger in scale than other renewable energy projects. This is especially relevant as projects move from predevelopment (with low expenditure) to the later stage of development (higher expenditure, leading to final investment decision) and due to the need to use global OSW experience, combined with local knowledge, in delivering successful projects.

Strategic approach to transmission

The Southern Mindoro potential OSW development zone is a key example of the importance of a strategic approach to transmission. To access its OSW potential will require strategic collaboration and timely progress in a range of areas, especially in transmission network upgrades and OSW project development.

Without a strategic approach, which involves both the definition of OSW development zones and clear, funded transmission network upgrades, the outcome is likely to be the delivery of only a small number of early OSW projects that can be connected to the transmission network without major upgrades, leading to increased demands on the national electricity system.

Suitability of conditions in the Philippines for offshore wind

The OSW industry started in the shallow waters of Northern Europe with high mean wind speeds. The industry is now globalizing rapidly, accessing markets with somewhat lower mean wind speeds and new challenges, such as typhoons. The industry is also rapidly commercializing floating OSW technology, which will be well-proven before first floating projects in the Philippines in the early 2030s.

The industry is developing wind turbines suited to lower mean wind speeds and designed to withstand wind speeds significantly higher than the 70 meters per second gust wind speeds that most models are designed to withstand. Robust technical solutions are being demonstrated by the leading wind turbine suppliers to meet these challenges. These advances mean that the OSW industry can use the windy but mainly deep waters of the Philippines by the time projects and transmission network upgrades are ready to go live.

Each recommendation is labeled **S (strategy)**, **P (policy)**, **F (frameworks)**, or **D (delivery)**, aiding reference to the World Bank Group's *Key Factors* report.[4] Parts of Sections 9 to 22 provide further detailed recommendations not listed here.

Many of the recommendations apply to both the low and high growth scenarios but can happen later and to a lesser degree in the low growth scenario. Recommendations marked **H (high growth scenario only)** may still be advantageous but could be avoided in the low growth scenario, and are not shown in Figure 5.3, giving a much-reduced list of roadmap actions.

Those recommendations with an *** indicate where early progress is critica**l to the timely delivery of the high growth scenario.

5.2 VISION AND VOLUME TARGETS

Communicating a clear long-term vision and associated volume targets for OSW will attract interest and investment from the global industry and supply chain, stakeholders, government departments, and the people of the Philippines.

Our recommendations to the DOE:

1. Publish its vision for OSW to 2050 as part of a decarbonized energy mix for the Philippines, considering plans for transport and heat, explaining how and why OSW is important. Through sectoral and economic analysis, this vision should show how OSW contributes to key elements of national energy strategy, taking a balanced view of costs and benefits. (See Sections 6 and 8). (S, H*)
2. Set OSW installed capacity targets for 2030 and 2040. (See Sections 6 and 8). (P*)
3. Progress a holistic feasibility study for the Southern Mindoro potential OSW development zone—due to its strategic relevance and long lead time for development—considering metocean conditions, transmission network, OSW, and port development. (See Section 9). (S, H*)

5.3 PARTNERSHIPS

The large scale and high complexity of OSW projects make it entirely different from onshore wind or solar. Projects combine the scale of large hydroelectricity schemes and the complexity of offshore hydrocarbon extraction. Therefore, government-industry collaboration builds confidence, develops a successful new sector, and delivers benefits seen in other markets.

Our recommendations to the DOE:

4. Establish by circular[v] a long-term government-industry task force involving local and international project developers and key suppliers to address these recommendations and other considerations, as they arise. (See Section 6). (F, H*)
5. Sign memoranda of agreement with relevant government departments, especially the Department of Environment and Natural Resources (DENR), to define interdepartmental cooperation on OSW, covering leasing, permitting, power purchase, transmission, health and safety, and frameworks, and key areas of delivery, including supply chain, ports, and finance. (See Section 6). (F, H*)

v Formal intergovernmental agency collaboration is usually in the form of a joint circular issued by such agencies or memorandum of agreement/cooperation agreement entered into between these agencies.

5.4 OWNERSHIP

The Philippines OSW sector must tackle a large scale of projects, which need vast overseas investment and a combination of local knowledge and international OSW experience.

Our recommendations to the DOE and the private sector:

6. Seek that Congress change the Constitution to relax requirement for 60 percent local ownership of each OSW project (bringing OSW in line with other renewables technologies, such as biomass) or find alternative routes to address this barrier to investment in large projects. (See Section 20). (D, H)

5.5 LEASING, PERMITTING, AND POWER PURCHASE

To develop a sustainable OSW energy industry, the Philippines needs robust, transparent, and timely processes for leasing and permitting. International investment is required to develop the potential volumes of OSW in the Philippines discussed in this report. The sector needs a stable route to selling electricity to make this happen.

Our recommendations to the DOE:

7. Establish OSW development zones through proportionate MSP in line with GIIP.[vi] Engaging with key stakeholders, planners need to consider E&S factors (including cumulative impact of multiple projects) and have a long-term vision for transmission network development. (See Sections 9, 14, and 18). (F, H*)
8. Introduce OSW development zones that respect WESCs and applications. Provide guidance in focusing OSW projects in the most advantageous areas, while minimizing negative E&S and economic impacts. See also recommendation 18. (See Section 9). (F, H)
9. Issue guidance to developers on how to accept requests to extend a WESC's predevelopment stage beyond five years due to considerations outside of the control of the developer. (See Section 16). (F)
10. Issue guidance regarding applying for a WESC for OSW adjacent to an existing WESC and give assurance to developers on the expectation to extend a WESC after the initial 25-year term if a project is still in operation. Confirm there is no requirement for offshore occupation fee. (See Section 16). (F)
11. Extend the Energy Virtual One-Stop Shop (EVOSS) activity to cover all relevant government departments to enable efficient and transparent permitting, including ESIA, in accordance with GIIP. Clarify and streamline permitting process and provide guidance for developers, regulators, and stakeholders, including clear timelines for permit decisions and prioritization of renewable energy projects. See also recommendation 32. (See Section 16). (F*)
12. Review design permit flexibility to prevent need for full reapplication and subsequent delays should any design changes be required as the project progresses, plus the availability and appropriateness of supporting guidance regarding the permitting processes, considering all parties. (See Section 16). (F)

vi GIIP, as defined by International Finance Corporation (IFC) Performance Standard 3 (PS3), is the exercise of professional skill, diligence, prudence, and foresight that would reasonably be expected from skilled and experienced professionals engaged in the same type of undertaking under the same or similar circumstances, globally or regionally.

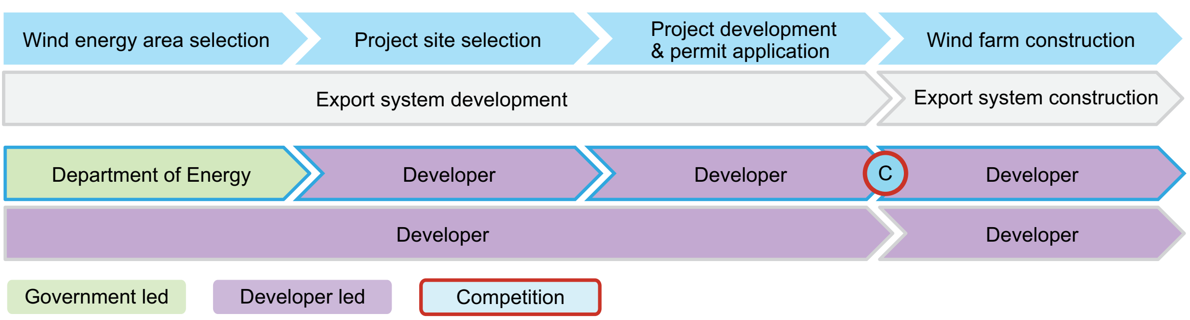
13. Establish a competitive system solely for OSW PPAs. Have a ceiling price to limit cost to consumers, and consider a floor price in early years to avoid the risk of lowball bids. Conduct ceiling and floor price consultations with stakeholders before to competitions to reflect evolving fossil fuel and OSW prices, especially recognizing currently high fossil fuel and commodity prices.[vii] (See Section 17). (F)

14. Explore development of a standard form PPA for adoption across OSW projects to accelerate market development to provide stable income per megawatt-hour generated and that may include indexation for foreign exchange rate variations. (See Section 20). (F, H)

15. Create a suggested timetable for private sector competitions. Coordinate across government and private sector organizations involved in administering competition to deliver. (See Section 17). (F)

Figure 5.2 summarizes recommended government and project developer responsibilities for OSW activities through the project lifecycle, showing the timing of the element of competition. This follows the format of Figure 3.4 of World Bank's *Key Factors* report, which presents responsibilities in a range of established markets.[4] The suggested Philippines model consists of an open-door leasing arrangement, followed by a competitive auction for PPAs. It is a one-competition model, but not combining lease and PPAs as in Denmark's or the Netherlands' one-competition models.

FIGURE 5.2 SUMMARY OF RECOMMENDED GOVERNMENT AND PROJECT DEVELOPER RESPONSIBILITIES FOR OFFSHORE WIND ACTIVITIES THROUGH THE PROJECT LIFECYCLE IN THE PHILIPPINES



Source: BVG Associates.

vii Note that a typical competition bid price cannot be directly compared with a LCOE for two main reasons: (a) PPA terms are typically for 20 to 25 years, shorter than the expected project lifetimes of more than 30 years; and (b) actual bid prices will consider account taxation and other fiscal and financial considerations, including those specific to each bidder. These are not included in LCOE calculations.

5.6 FINANCE

Enabling sufficient finance and reducing the cost of capital for OSW projects in the Philippines are key drivers in enabling volume delivery at low LCOE.

Our recommendations to the DOE:

16. Ensure PPA counterparties (offtakers) and PPA terms remain viable as volumes of OSW contracted increase, including clarity on curtailment. (See Section 21). (F, H*)

Our recommendations to the Department of Finance:

17. Encourage financial mechanisms to reduce cost of capital, including access to climate and other concessional finance. Ensure international market standards for contractual risk allocation, arbitration, and government backstop and an adequate security package for lenders. (See Section 21). (F)

Our recommendations to the DOE:

18. Support engagement of local finance community with OSW, including communication of E&S performance standards required to gain access to concessionary and project financing. See also recommendation 32. (See Section 21). (D)

5.7 GRID CONNECTION AND TRANSMISSION NETWORK

The transmission network offers only limited opportunity for grid connection of early projects via local upgrades. The Philippines needs significant strategic leadership and finance to deliver a transmission network enabling large-scale electrification and fit for a decarbonized energy system powered by renewable energy. This topic is much wider than OSW, considering all electricity, transport, and heat.

Our recommendations to the DOE:

19. Publish a 2050 vision for a nationwide electricity transmission network for a decarbonized energy system that includes milestone plans for 2030 and 2040 and considers finance. (See Section 18). (S, H*)
20. Incorporate OSW development zones into CREZ and transmission development plan (TDP) processes. (See Section 18). (F, H*)
21. Undertake power systems studies—with the DENR, National Grid Corporation of the Philippines (NGCP), and Transmission Corporation (TransCo)—to understand the potential impacts of large volumes of OSW on the future transmission network and ESIAs in line with GIIP and lender requirements. These studies will help policy makers understand the E&S implications of transmission network upgrades, feeding these into MSP activities. (See Section 18). (F, H*)
22. Work with NGCP and TransCo to update the TDP delivery, approval processes, and grid management practices to reflect the move to more supply from renewable energy sources. (See Section 18). (D)

23. Consider low-cost solutions for investment in transmission system upgrades, such as concessional finance. (See Section 18). (D, H)

24. Ensure clarity and efficiency for projects in securing grid connections, including point-to-point applications and compensation for delayed grid connection availability once a Grid Connection Agreement (GCA) is signed. (See Section 18). (F)

5.8 PORT INFRASTRUCTURE

Suitably sized and located ports are essential to enable the construction and operation of OSW farms. The Philippines has a range of such ports, though availability and interest in delivering OSW has not been established.

Our recommendations to the Philippines Ports Authority:

25. Publish (or have published) a OSW ports prospectus, showing port capabilities against OSW physical requirements, and use this to encourage dialogue and timely investment in relevant port facilities. This will involve engagement with independent government entities managing Freeports. (See Section 19). (D)

26. Work with the DOE and ports to plan a pipeline of projects in the potential OSW development zones in line with a strong government vision. Assess whether it is viable to establish new port facilities. Planners should factor E&S considerations and conduct a robust ESIA for potential developments. (See Section 19). (S, H)

27. With the DOE, Department of Trade and Industry (DTI), National Economic and Development Authority (NEDA), and relevant Freeport zone authorities, explore potential Philippine government and inward investment to finance port upgrades or new facilities. (See Section 19). (D, H)

5.9 UNDERSTANDING THE MARINE ENVIRONMENT

Available resources and natural conditions contribute to LCOE and decisions about where OSW should be located. Global datasets have established the viability of OSW in the Philippines. Further understanding is required to underpin strategic decision making.

Our recommendations to the DOE:

28. Initiate or coordinate wind resource measurement to build confidence in available resource and extreme winds, recognizing typhoon risk.[viii] (See Section 9). (S, H)

29. Initiate or coordinate other measurement and data gathering campaigns on key aspects of the zones as part of a proportionate MSP process, including:

    a. Metocean campaigns, especially wind speed but also considering typical and extreme significant wave heights and currents
    b. Geological surveys of the seabed and substrates
    c. Ecological surveys to address identified gaps in knowledge of the zones
    d. Social perceptions and potential impacts on local industries such as fishing, shipping, aquaculture, and tourism (see Section 9) (F, H)

5.10 SUPPLY CHAIN DEVELOPMENT

The Philippines' good port infrastructure could host local manufacturing. It has supply chain capability relevant to some areas of OSW. A proactive approach will help increase local readiness for supply.

Our recommendations to the DOE:

30. With the DTI, present a balanced vision for local supply chain development, encouraging international competition. Enable education and investment in local supply chain businesses, including in onshore and offshore worker training. (See Section 11). (D)
31. Learn from other OSW markets to avoid restrictive local content requirements that add risk and cost to projects and slow deployment. (See Section 11). (P)

5.11 STANDARDS AND REGULATIONS

Safeguarding E&S interests, designing and installing safe structures, and protecting workers are priorities at all levels of the industry. The Philippines needs a framework of E&S impact assessment standards, technical legislation, and design codes to establish bankability and attract and sustain international interest and investment in the market.

Our recommendations to the DENR:

32. Review ESIA requirements for compatibility with international standards of GIIP, update the legislative and policy framework where necessary, and produce guidance for developers and stakeholders on the requirements and their relationship with the permitting and financing processes. (See Section 14). (F*)

Our recommendations to the DOE:

33. Extend the Renewable Energy, Safety, Health and Environment Rules and Regulations (RESHERR) to cover health and safety for OSW. Encourage focus on behavioral and cultural aspects of health and safety. (See Section 15). (F)
34. With the Energy Regulatory Commission (ERC), consider amendments to the Grid Code and Distribution Codes to account for the significant increase in renewable power from OSW and other variable forms of renewable energy generation. (See Section 18). (F, H)
35. Create a framework of technical codes and regulations relevant to OSW, adopting international industry codes where appropriate. (See Section 6). (F, H)

5.12 CAPACITY BUILDING AND GENDER EQUALITY

Strong frameworks deliver only if they are implemented through agencies with clear roles, well-defined mandates, and sufficiently resourced staff. Gender equality is needed for an excellent pool of capability, both among stakeholders and the OSW industry, and to establish a future-focused industry. According to the World Economic Forum's *Global Gender Gap Report 2021*,[8] the Philippines is the 17th highest ranked country (out of 156) and the best-performing country in East Asia in closing the gender gap around key metrics. OSW can build on this success.

Our recommendations to the DOE:

36. Help government departments and other key stakeholders grow capacity and knowledge needed to process a growing volume of OSW projects. (See Section 16). (F*)
37. Involve developers and supply chain companies in gender equality working groups, supported by women's rights organizations in the Philippines, Global Wind Energy Council (GWEC) and Global Women's Network for the Energy Transition (GWNET). (See Section 13). (D)
38. Consider introducing gender equality requirements into leasing and power purchase frameworks. (See Section 13). (F)

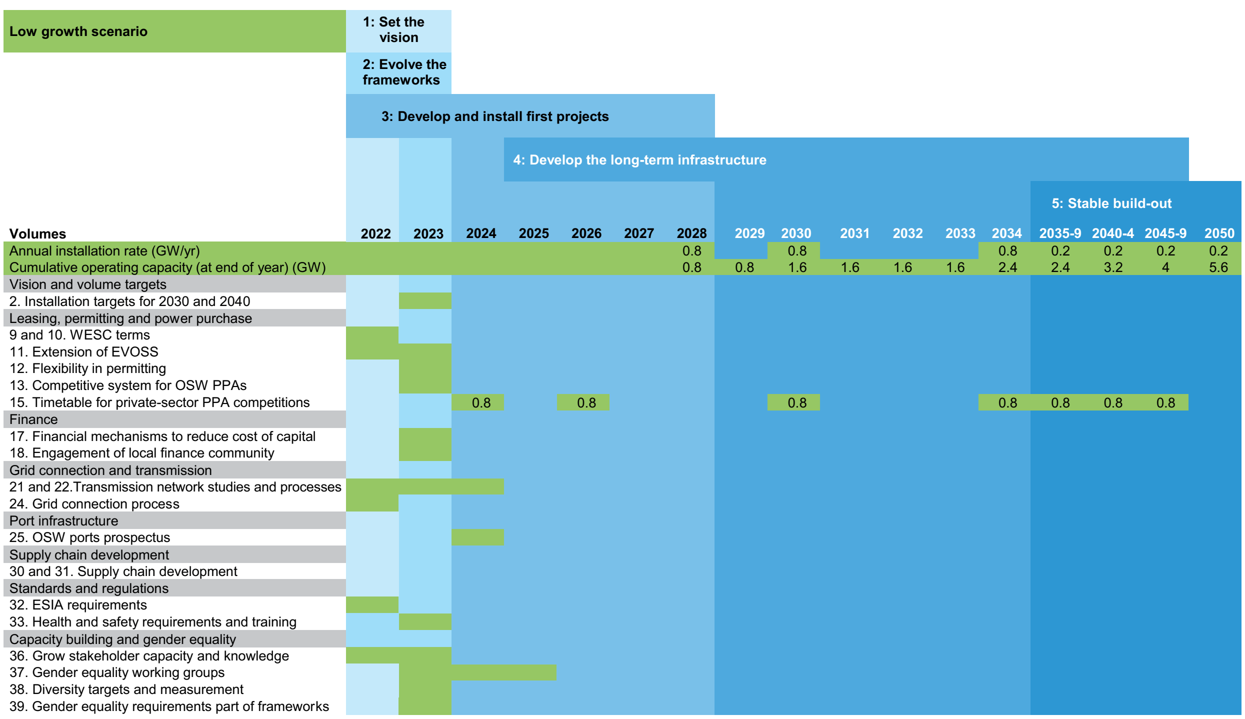
Our recommendations to the government and industry:

39. Together, determine key data to collect to ensure diversity targets are measured and make sure a framework is in place to collect data accurately. (See Section 13). (D)

5.13 ROADMAP SUMMARIES

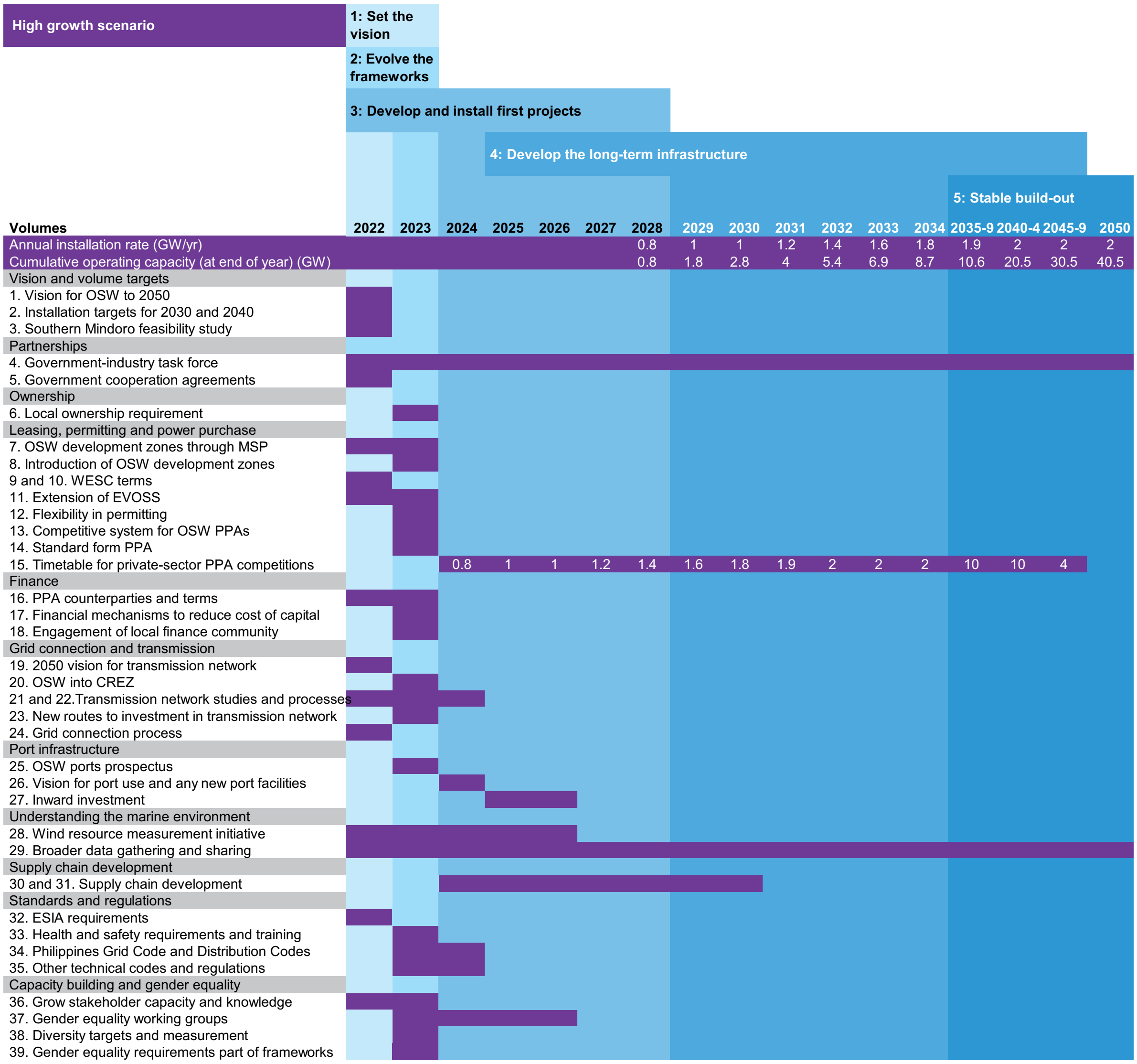
Figures 5.3 and 5.4 present roadmap summaries for low growth and high growth scenarios, respectively.

FIGURE 5.3 LOW GROWTH SCENARIO ROADMAP FOR OFFSHORE WIND IN THE PHILIPPINES



Source: BVG Associates.
Note: ESIA = environmental and social impact assessment; EVOSS = energy virtual one-stop shop; OSW = offshore wind; PPA = power purchase agreement; WESC = wind energy service contract.

FIGURE 5.4 HIGH GROWTH SCENARIO ROADMAP FOR OFFSHORE WIND IN THE PHILIPPINES



Source: BVG Associates.

SUPPORTING INFORMATION

6. KEY FACTORS FOR SUCCESSFUL DEVELOPMENT OF OFFSHORE WIND IN AN EMERGING MARKET

This section summarizes key ingredients for a successful OSW industry based on experience in a range of countries, mainly captured in World Bank Group's *Key Factors* report.[4]

It is recognized that each market will have different strategic drivers and considerations, so while generic key factors are important, learning always needs to be applied in context. In response to the key factors, we have included a commentary specific to the Philippines and reference to recommendations presented in Section 5.

6.1 A CLEAR ENERGY STRATEGY

OSW should be considered as part of a long-term energy strategy alongside other forms of energy production, in the context of the electrification and decarbonization of national energy systems looking toward 2050. By then, the majority of fossil fuel use in electricity production, transport and heat will have ended, and the majority of energy production will be from renewable sources—biomass, geothermal, hydro, ocean, solar, and wind. Typically, OSW projects provide large-scale electricity generation, with higher capacity factors than onshore wind and solar projects. As it stands today, storage of energy is likely to be mainly through hydrogen and electric vehicles, and hydrogen is likely to be an important vector for some forms of energy use, including in larger vehicle transport.[viii]

This means countries should ask themselves the following questions:

- Where will our energy come from?
- How do we manage the cost and risk of this supply?
- How will we get energy from where it is extracted to where it is used?
- Should OSW be a big part of our energy future?

The global OSW industry will respond positively to clarity about OSW's role in a given country's future energy system. It has to invest much in an emerging market, so it will want to pick the right markets. These are the ones where OSW makes most sense and it can see that governments understand and are making progress on the opportunities.

Section 1 of the World Bank Group's *Key Factors* report discusses this area in more detail.[4] The Philippines is well placed, with World Bank Group and other support, to develop the next iteration of its energy strategy.

Our recommendations 1 and 19 relate to this point.

viii The cost of producing hydrogen is likely to remain higher in the Philippines in the near future than in countries with low cost, large-scale onshore renewables.

6.2 STABLE OFFSHORE WIND POLICIES AND PIPELINE VISIBILITY

Sufficient, attractive lease areas for development

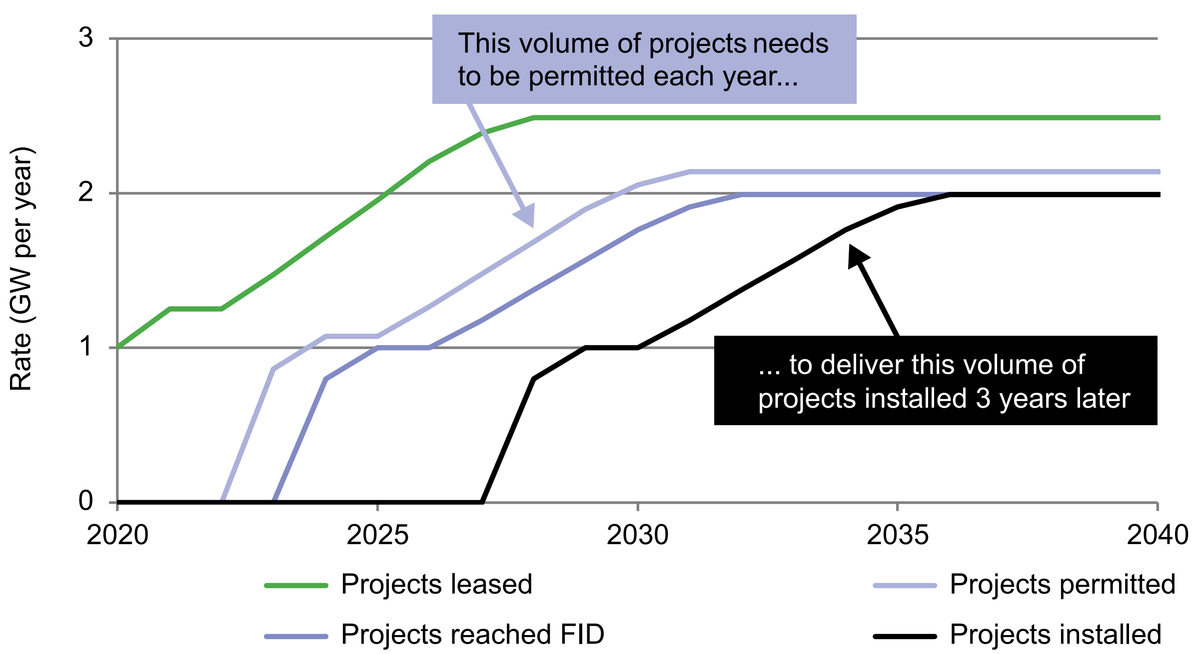
OSW project developers and their supply chains need to have confidence in a sufficiently large and visible pipeline of projects to facilitate investment, ongoing learning, and competition.

The way leases are allocated also needs to be transparent, robust, and bankable to enable developers to invest confidently at an early stage. Proportionate marine spatial planning processes can be used to de-risk potential lease areas by identifying environmental and social risks and prioritizing areas for development.

The Philippines has a relatively attractive OSW resource and establishing a pipeline of 2.5 GW per year leased by 2027 will enable 2 GW per year to be installed by 2035.

The phasing of key activities is presented in Figure 6.1. This chart includes realistic levels of attrition, where projects are delayed, resized or fail due environmental, technical, or commercial reasons. It is indicative and does not fully reflect the pipeline of Wind Energy Service Contracts that have already been signed. It shows, however, that reaching an annual rate of lease awards of 2–3 GW by 2025 is key if the Philippines is to follow the high growth scenario and reach 2 GW of installed capacity each year by 2035.

FIGURE 6.1 ANNUAL RATE OF MEETING DIFFERENT OFFSHORE WIND MILESTONES REQUIRED TO DELIVER HIGH GROWTH SCENARIO



Source: BVG Associates.

The chart is based on the following headline typical project timeline:

- *Year 0: project leased.* For the Philippines, this means Wind Energy Service Contract awarded.
- *Year 4: project permitted.* For the Philippines, this means that sufficient permissions have been obtained to be eligible to enter a power purchase auction.
- *Year 5: project reaches final investment decision (FID).* In the Philippines, this will come after having secured a power purchase agreement (PPA).
- Year 8: project installed.

There is the opportunity for governments to shape some elements of this timeline, and a general speeding up can be expected over time. It is compatible with that seen in established markets as we anticipate that much learning can be applied from them to frameworks in the Philippines to enable similar timing, and the time from lease to installation in a typical market will continue to fall over the next two decades—in all markets, there are some projects that significantly delayed. Time scales shown therefore are indicative, purely to flag that frameworks need to be working smoothly before first capacity starts coming online.

This roadmap suggests a solid basis for establishing a healthy pipeline of OSW projects, especially through the use of OSW development zones.

Our recommendations 2, 7, 8, 9, 10, and 36 relate to this point.

Streamlined permitting process

Many countries have learned that a clear, efficient, well-resourced permitting process incorporating good practice for environmental and social impact assessment (ESIA), led by a single organization, and with clear accountabilities and basis for decisions is key, both in terms of minimizing environmental and social harm and facilitating project financing by meeting the performance standards of international lenders.

The Philippines is already taking positive steps in this area, for example via the Energy Virtual One-Stop Shop (EVOSS), but there is more to be done to facilitate a pipeline of permitted projects.

Our recommendations 11, 12, 32, and 36 relate to this.

A regime that de-risks developers' exposure to long-term energy price fluctuation

Wind farm owners are exposed to significant project development and construction risk, and ongoing risks relating to wind speeds and project performance. Additional risks due to grid curtailment and variable sales price of electricity generate additional financing cost to projects, increasing the cost to consumers. There are also risks related to retrospective changes to tariffs. Countries that have made fast progress on OSW deployment have managed exposure to this risk via robust, government-backed contracts and stable policy. In some markets, these are now not at a premium to wholesale, variable electricity prices.

The Philippines has existing processes, as discussed in Section 17, but it is likely that these will need to be strengthened, especially in the high growth scenario.

Our recommendations 13, 14, 15 and 16 relate to this.

Stable and transparent investment environment

As well as confidence in the wind farm leasing, ESIA, and permitting processes, wind farm developers and investors need to be confident about the legal, financial, and tax regimes in any market to consider investments bankable.

Having a recognized framework of technical legislation and design codes and standards also helps establish bankability and attract international investment. A balance needs to be found between adapting existing national standards relevant to other industries and adopting international OSW good practice, which reduces the risk and cost for international players to supply to the Philippines.

The Philippines has a good basis for development and a strong local banking sector and an excellent opportunity to engage with the global OSW finance community and those providing concessional finance.

Our recommendations 4, 6, 17, 32, 33, 34, 35, and 36 relate to this.

6.3 A STRONG AND ACCESSIBLE TRANSMISSION NETWORK

Transmission network

A robust transmission network to take power to areas of demand, with low risk of uncompensated curtailment, is key for project developers. Often, waiting for a grid connection and associated transmission upgrades are the longest-lead items in an OSW project development.

Section 18 shows that substantial investment will be required in the Philippines transmission system. Design, investment, and implementation of new transmission assets is a long-term activity that needs to be accelerated for reasons wider than OSW, including via access to concessional finance.

Our recommendations 19, 20, 21, 22, 23, and 34 relate to this.

Timely grid connections

At the individual project level, project developers need to be confident that as they increase project spend, once they have agreed a grid connection date, they will be able to connect on that date. Delays between large capital spend and first generation add significantly to levelized cost of energy (LCOE), due to the cost of finance.

Our recommendation 24 relates to this.

6.4 A COHERENT INDUSTRIAL POLICY

Policies that encourage realistic levels of local supply while keeping a close focus on cost

OSW can provide valuable jobs and local economic benefit. Good industrial policy balances cost to the consumer and job creation. Industry can help find optimal ways to work with the government to achieve these objectives.

Local site conditions and research and development (R&D) capabilities in each country also offer opportunities to reduce the cost of energy through innovation. In East/Southeast Asia, the OSW industry is facing new challenges due to earthquakes, tsunamis, typhoons, and different ground conditions than those in Europe. As the industry progresses, there will continue to be new areas where government R&D support will both reduce the cost of energy and create local value.

Our recommendations 4 and 30 relate to this point.

Ports

There is always a way to install any given OSW project from available ports, but often compromises have to be made that add to the cost. Early, strategic investment can both reduce cost for a range of projects and in some cases, help establish clusters of suppliers in a given area, with benefits in terms of collaboration and shared learning.

In most cases, port infrastructure will be used by different companies and different projects over many years. Section 19 shows that the Philippines has sufficient port infrastructure to be able to meet the requirements of the current and future OSW projects, often with relatively minor investment.

Our recommendations 25, 26, and 27 relate to this.

6.5 RESOURCED, JOINED-UP INSTITUTIONS

OSW introduces new leasing, permitting, and other regulatory considerations. The Philippines can address this by ensuring that its public institutions have the necessary skills and resources to give robust and timely decisions, and that these organizations and their processes work well together.

These organizations will be involved in marine spatial planning, environmental management, leasing sites, permitting and administering revenue mechanisms. When well-resourced, these institutions create an environment where industry has confidence to make business decisions and governments can plan public spending and have confidence that their policy objectives are being achieved.

It is not just the organizations directly involved in the support of the OSW industry that need resources. OSW projects have implications for military and aviation organizations, environmental protection agencies and a range of nongovernmental organizations and other stakeholders.

Staff need training to use knowledge and implement good practice learned elsewhere in the world over the previous 20 or so years of the OSW industry.

Gender equality is key to the development of an excellent pool of capability, both within stakeholders and within the OSW industry, and is an important focus for establishing a future-focused industry.

Our recommendations 5, 36, 37, 38, and 39 relate to this.

6.6 CONFIDENT, COMPETITIVE ENVIRONMENT

Confidence

We have discussed the importance of confidence and ways to build it in many of the subsections above. One further way of building confidence is to establish ongoing government-industry collaboration involving local and international project developers and key suppliers, to work together to address challenges and opportunities over the years, as the industry matures.

Our recommendation 4 relates to this.

Competition

Competition increases efficiency and innovation between developers and across the supply chain. This reduces cost of energy and improves value to consumers.

Energy markets around the world range from fully liberalized to state-controlled markets. Regardless of the system, we have found that competition can have a significant impact on power price reduction.

Good competition for enough sites and PPAs means the best projects get built and offer best value. Competition for finance is also important, as the cost of finance contributes significantly to LCOE.

Our recommendations 13, 15, 18, 30 and 31 relate to this.

6.7 SUPPORTIVE AND ENGAGED PUBLIC

OSW farms affect the lives of many, and it is important that the voices of individuals, communities and organizations are heard and are involved at an early stage of the development process, and that they understand the potential environmental, social and economic impacts of the industry.

Governments can provide an important channel for these voices and the industry will listen. Governments and other enabling organizations can also educate on the benefits of OSW, including environmental benefits, job creation and local economic development.

The process of public and stakeholder engagement, for example with fishing communities, can start much earlier than project development and will be an ongoing process including marine spatial planning, ESIA, and ongoing construction and operational management.

Our recommendation 7 relates to this.

6.8 A COMMITMENT TO SAFETY

Working in OSW by nature is potentially hazardous due to the location, the need to work at heights, the size of the components involved, and the presence of medium and high voltage electrical systems.

The OSW industry protects its workers by seeking to get it 'right first time'—its aim is to anticipate mistakes rather than just learn from them.

The Philippines has a platform to build on, with its offshore oil and gas and onshore wind industry, but there is work to be done to ensure regulatory clarity and reinforce safety practices. It is important also to ensure strong communication and collaboration across industry. The G+ Global Offshore Wind Health and Safety Organization already has an Asia-Pacific (APAC) focal group to engage with. The Global Wind Organization (GWO) provides a robust framework for OSW health and safety training and certification.

Our recommendations 33 and 35 relate to this.

6.9 USING THE BEST LOCATIONS

For the Philippines to realize all the positive benefits that OSW has to offer, it has to strike the right balance between the cost of energy from OSW farms with impact on the natural environment, local communities, and other users of the sea.

The Philippines should focus on developing a comprehensive framework of marine spatial planning that seeks to achieve the above balance and provides clear direction to project developers and investors that responsibly and respectfully developed OSW is welcomed and encouraged.

Making use of natural resources

The Philippines has valuable OSW resources. Identifying the right places in the Philippines to locate OSW farms is an important aspect of developing a sustainable and long-term industry.

The cost of energy from OSW farms varies from site to site, depending on factors including local wind and seabed conditions, water depth, and distance from shore. Data sets relating to these considerations are limited at present.

Our recommendations 3, 7, 28, and 29 relate to this.

Protecting the environment

One of the drivers behind developing OSW as an energy source is its positive environmental benefit as a source of carbon-free electricity.

Nonetheless, it is important to recognize that OSW farms are large industrial developments and that their construction must be achieved in a way that minimizes harmful localized impacts on natural and human environments. A wide range of environmental and social considerations are examined in detail in Sections 9 and 14. The government should avoid areas of highest environmental and social sensitivity through spatial planning; implement a robust permitting process where the design, construction and operation of OSW farms is delivered in accordance with GIIP and standards, including those for ESIA.

Our recommendations 11, 12, 29, 32, and 36 relate to this.

Respecting communities

For OSW to have a sustainable future, the rights of people and communities whose lives and activities interact with OSW farms must be respected.

OSW farm sites in the Philippines must be identified, assessed, permitted, and developed in a way that is sensitive to people's livelihoods, to the recreational interests, and to their cultural heritage.

Our recommendations 7 and 29 relate to this.

7. BENEFITS AND CHALLENGES OF OFFSHORE WIND

7.1 BENEFITS

- *Local.* Once installed, it does not rely on fuel imported from other countries, so increases energy security.
- *Low cost.* Lifetime costs are still reducing quickly, while for traditional fossil fuel options, costs are rising. It is becoming easier to finance OSW projects at the same time as it becomes more difficult to finance fossil fuel generation.
- *Large scale.* GW-scale projects can be constructed quickly compared to traditional power stations.
- *Long-term jobs.* Both leading up to and during operation, OSW creates and sustains local jobs and local economic benefit, especially in coastal regions.
- *Clean.* OSW is low carbon, low air pollution, low water use, and low land use.

Local

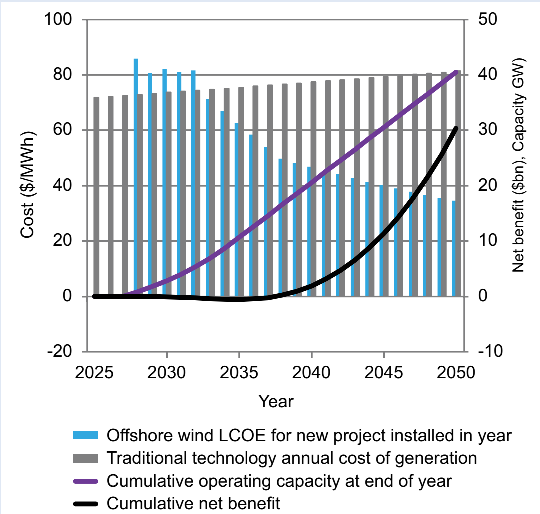
Currently, the Philippines' electricity supply is mainly from coal, gas, hydro and geothermal power. Under the Clean Energy scenario of the Philippines Energy Plan 2018–2040, future demand is planned to be met by increases in natural gas and renewable energy sources, such as wind and solar, displacing oil and coal in the energy supply mix.

While it uses its own natural resources to create electricity from gas, geothermal, and hydro, the Philippines imports a growing percentage of its coal and oil demand from Australia, Russia, Singapore, Indonesia, and the Middle East. The main indigenous natural source of gas for the Philippines comes from the Malampaya Gas Field operated by Shell Philippines Exploration together with consortium members, Chevron Malampaya LLC and PNOC Exploration Corporation. It is expected that the Malampaya gas field will be completely depleted by the first quarter of 2027. New LNG terminals are being planned and constructed in Luzon to replace this source of natural gas with imported gas. OSW, along with onshore wind and solar, offers the chance for further energy independence, increasing energy security for supply and improving the Philippines' trade balance.

Low cost

In Europe, OSW is cost competitive with new-build fossil fuel options. In the high growth scenario considered here, the Philippines will reach the same position by 2028 for fixed projects, and 2032 for floating projects, and the trend of reducing cost will continue into the 2030s and 2040s, as technology and the supply chain continues to develop.

EXPLANATION OF FIGURE 3.2 AND FIGURE 4.2: LCOE AND CUMULATIVE NET BENEFIT OF OFFSHORE WIND



Source: BVG Associates

The blue bars show the levelized cost of energy (LCOE) for OSW installed in the given year, assumed constant for the life of each project. The average cost of production in a given year (not shown) is made up of higher LCOE of earlier projects and lower LCOE of later projects, combined with capacity factors for each. It is made up of costs from fixed and floating projects following the scenarios presented in Section 2.

The gray bars show the average cost of production for traditional technology (assumed to be coal) operating in a given year, assumed to increase slowly over time due to fuel price inflation and other carbon abatement measures.[ix] Traditional technology was chosen as the early comparator, as it is the incumbent technology and can be provided in large volume, like OSW. As the energy transition progresses, many countries will move to increased use of onshore renewables (wind and solar) as well as OSW. The longer-term LCOE of onshore renewables in the Philippines will depend both on the progress in improving the cost effectiveness of installed hardware and on the availability of economically exploitable resources, based on environmental and social considerations. Analysis of this is relevant, in time. It is likely that it will show a need for both available onshore renewable capacity and OSW.

The purple line shows the cumulative installed capacity of OSW in this scenario.

The black line is the cumulative net generation cost benefit of production from OSW based on the difference in average cost of production between OSW and coal, each year. The analysis is based on project costs only, with OSW simply offsetting traditional technology. It is not based on any power system modelling and does not consider the cost of carbon dioxide or other pollutants or of balancing costs due to the variability of OSW generation. It therefore has a narrow definition, using information available to the project team, that does not consider wider fiscal benefits and subsidies. In time, it may be beneficial to conduct a broader assessment in this area.

In this example, the net benefit to consumers by 2040 is already US$1.9 billion.

Traditional technology fuel price inflation and other carbon abatement measures are approximate, set to US$70 per MWh in 2020 (lower than recent coal auction prices), with an inflator of 0.5 percent per year. Note that as of March 2022, coal prices are at historical highs and thus, US$70 per MWh does not reflect recent pricing shifts with electricity generation from coal becoming significantly more expensive, at least in the shorter term.

Sensitivity Analysis

To understand sensitivity, if the traditional technology price inflation is reduced to zero, then in the high (low) scenario, the net generation cost benefit in 2040 would be minus US$0.6 billion (minus US$0.8 billion).

If the traditional technology price inflation is retained, then in the high (low) scenario, the net generation cost benefit in 2040 drops (increases) to zero when the 2020 traditional technology price is set to US$66 per MWh (US$74 per MWh).

ix For any given OSW project, the LCOE, by definition, is constant over the project life. LCOE for a pool of projects changes as new projects with different LCOEs are added into that pool. For coal, as much of the production cost is dictated by the fuel price, which is expected to increase over time, the concept of LCOE is less suitable. Here, we have compared LCOE for the pool of OSW projects operating in a given year with the cost of production from the coal plant in that year.

Large scale

The capacity of OSW projects in mature markets are usually between 0.5 GW and 1.5 GW. In 2021, early phases of the Dogger Bank project in UK that will be developed together won power purchase contracts totaling 3.6 GW, and a similar-sized project is progressing in Vietnam. Larger OSW turbines continue to be brought to the market, the largest now at 15 MW, further enabling large projects to be constructed rapidly. Typically, these GW-scale projects can be constructed more quickly than fossil fuel plants, and in some markets in Europe, the introduction of OSW has significantly increased the overall deployment rate for renewables when onshore renewables had slowed due to delays relating to permitting and the lack of availability of viable sites. While a typical OSW project is likely to take considerably longer to develop and install than a typical onshore wind or solar project, OSW has proven to be an effective way of developing multiple GW of capacity in reasonable time scales.

Long-term jobs

OSW offers local job opportunities in developing, manufacturing, construction and operation of OSW projects, over their life cycle of over 30 years. Section 12 explores the scale of the opportunities, based on an analysis of the supply chain in Section 11.

Clean

OSW produces less carbon dioxide and other pollutants and uses less water and land than fossil and nuclear sources of generation.

Carbon

Fossil fuels release on average 500 metric tons of carbon dioxide (CO_2) per GWh of electricity generated.[9, 10] A typical 1 GW wind farm saves over 2.2 million metric tons of CO_2 per year. In the Philippines, emissions from coal are likely to higher than quoted above, further increasing the saving. In the high growth scenario, by 2040 OSW will have produced almost 400 TWh, saving about 200 million metric tons of CO_2, cumulatively. This equates to a saving of between US$11.5 and US$23 billion based on the WBG's carbon pricing guidance which suggests the price of carbon ranges from between US$50–100 tCO2e between 2020 and 2030 and increases for both values at the same growth rate of 2.25 percent per year to 2050.[11] In the low scenario, the saving is just over 40 million metric tons which is equivalent to between US$2.4 and US$4.7 billion. These savings are not included in the analysis of cumulative net benefit presented above. Further, we recognize that while OSW will mainly displace coal, there may be times when lower-carbon technologies are displaced, or when renewables capacity needs to be curtailed to meet demand. This could be evaluated via more detailed sectoral and economic analysis.

Analysis by Siemens Gamesa Renewable Energy found that an OSW farm pays back the carbon produced during construction within 7.4 months of the start of operation. The life of an OSW farm is likely to be 30 years or more.

Pollution

Sulphur dioxide (SO_2) and nitrogen oxides (NO_x) are air pollutants known for creating smog and triggering asthma attacks.

Fossil fuels release on average 1.1 metric tons of SO_2 and 0.7 metric tons of NO_x per GWh of electricity generated.[13] In the high growth scenario, OSW saves over 430,000 metric tons of SO_2 and 275,000 metric tons of NOx, cumulatively by 2040.

As an example of public health benefits from other markets, the American Wind Energy Association estimated that reductions in air pollution created US$9.4 billion in public health savings in the US in 2018 from the 96 GW of onshore wind generated in the US that year.[14]

Water

Thermal power plants require water to produce electricity and cool power generating equipment.

Fossil fuels consume on average 15 million liters of water per GWh of electricity generated.[15] Wind farms require very little water. In the high growth scenario, OSW saves almost 6 trillion liters of water by 2040, with a 1 GW wind farm saving 65 billion liters of water per year.

Land

Onshore renewable energy projects are often constrained by local population density and competing land uses. The onshore footprint of OSW is limited to grid infrastructure and port facilities. OSW, located and developed properly, typically does not have a large impact on other marine users.

7.2 CHALLENGES

OSW, like any new technology and infrastructure investment has significant challenges. These include

- *Variability*. The wind does not blow all the time.
- *Technology*. Cost of energy reduction depends on the development of technology overseas that is both reliable and well suited to conditions in East Asia.
- *Cost in the early years* Initially, costs will be higher than in more mature OSW markets and can be higher than traditional forms of electricity generation.
- *Young, rapidly growing industry*. This introduces both risks and opportunities that need to be managed.
- *Government commitment*. Cost reduction, especially local economic benefits, increase with volume and requires greater government commitment.
- *Environmental and social considerations*. The local, regional, and international adverse impacts of OSW need to be recognized and carefully managed.
- *Impact of climate change*. How OSW could be impacted by climate change.

Variability

Seasonal variations in average wind speeds are well understood in mature markets, but total annual energy production can still vary by 10 percent from year to year. In these markets, forecasts for a few days ahead are relatively accurate, but predictions of energy production still need either supply- or demand-side action to ensure continuity of power supplies.

It is recognized that there is a cost to addressing this variability. Investment in the energy transition inevitably involves investment in smart grid technology, flexible sources of generation, storage and management solutions, including the use of hydrogen and electric vehicles, each helping to manage the challenge of variability of generation from wind and solar. With many other markets having far higher penetration of variable renewables than the Philippines, it will be able to take advantage of technology and commercial learning in other markets as these areas develop over the next 30 years.

Technology

The continued reduction in cost of energy from OSW in the Philippines relies on further development and support of new technology, especially

- Larger offshore turbines, plus all the logistics and equipment related to their use;
- More optimized floating foundations and associated mooring systems, installation methods, and operational strategies;
- Ongoing global improvement in the manufacture, installation, operation, and reliability of OSW farms; and
- Solutions to address site conditions specific to the area, including typhoons and seismic activity.

The first three points relate to OSW, globally; the last relates especially to the East Asia market.

For the past 30 years, the wind industry has been innovating rapidly, and we anticipate that this will continue. There is, however, a risk that local markets are not large enough to drive some areas of innovation.

There also remains a risk of type faults causing significant reliability issues, especially as OSW turbines incorporate a range of technology at the largest scale that it is used in volume, globally.

Cost in the early years

In Europe, OSW used to be much more expensive than traditional technologies. With competition, innovation, and learning, the cost has been reduced by a factor of more than 3 in the last decade.

In new markets, not all this cost reduction will be available, as the supply chain and experience will take time to grow, and solutions to country-specific challenges will take time to develop.

This means that, as shown in Section 10.3, costs will start higher but come down faster than in an established market.

Our analysis shows that the getting through this period of higher costs takes less time via the high market scenario (for example floating OSW reaches US$60 per MWh three years earlier in the high growth scenario than in the low growth scenario, refer Figure 10.2), and in any case, even during this time, consumer net benefit is positive, even without taking account of the climate and pollution benefits.

Young, rapidly growing industry

The wind industry is only 30 years old, and it is less than 20 years since the OSW industry started installing one or more projects each year. Many significant global businesses are involved, but any young and rapidly growing industry presents challenges in terms of mergers and acquisitions and changes of strategy at a pace faster than seen in more mature sectors.

Government commitment

As seen in Figure 3.2 and Figure 4.2, more benefits are unlocked by the high growth scenario, but this requires more urgency and commitment from the government to delivery, bringing challenges of cost and resources. Common challenges are in establishing robust and transparent frameworks for leasing, permitting, power purchase, and grid connection. These areas are discussed in subsequent sections of this report and in the World Bank Group's *Key Factors* report.[4]

Environmental and social considerations

As with any large infrastructure project, OSW farms do have local adverse impacts on ecosystems, habitats and species, other sea users, and on local communities. These impacts can be international in scale, considering cumulative impacts, which are difficult to manage. OSW should not be located in areas of highest environmental and social risk, which can be identified at an early planning stage.

In established OSW markets, robust environmental and social impact assessment processes and high levels of stakeholder engagement are used to ensure that these impacts are identified and managed carefully. This requires considerable environmental and social baseline data collection, some of which can take two years or more. This requirement for data collection needs to be factored into the permitting arrangements, providing enough time to collect such data prior to construction.

Impact of climate change

It is recognized that the Philippines has high vulnerability to climate change impacts. We do not believe that OSW will be significantly affected by climate change. Key considerations include

- *Temperature rise.* OSW projects are not susceptible to even increases in mean temperature of 2 degrees or more, based on typical project specifications and our understanding of key design drivers.
- *Seal level rise.* OSW projects are not susceptible to even increases in mean seal level of 1 meter or more, again, based on typical project specifications and our understanding of key design drivers.
- *Changes in weather patterns.* There is a risk to the viability of OSW projects should the long-term trend in mean wind speeds be downwards, or if most extreme high wind speeds increase. So far, there has been no compelling evidence regarding mean wind speeds. Globally, there is evidence of more extreme weather patterns.

7.3 FLOATING OFFSHORE WIND

Beyond the benefits and challenges discussed above, there are some important additional considerations relating to floating OSW that are discussed below.

Minimal differences between floating and fixed offshore wind hardware

- **Typically, turbine design, operation, and reliability are almost the same.** This means that the technology can be fully shared across markets. The only significant difference is in tower design, where the same principles and suppliers are used for both markets.
- **Turbine routine maintenance activities are almost the same.** Activities using crew transfer vessels (CTVs) and service operation vessels (SOVs) are unchanged. Only unplanned service of major components is different, due to the inability to use bespoke jack-up installation vessels for floating OSW activities.
- **Export system electrical hardware is the same, except for some mechanical aspects of cabling.** The way that cables are designed and supported near foundations and substations changes due to relative movement between foundations and compared to the seabed, otherwise, some aspects of cable laying can be made easier due to deeper water. Mechanical aspects of offshore substations and their foundations and installation also change, as they move from being mounted on fixed to floating foundations.

Additional benefits beyond fixed offshore wind

- **Floating OSW allows access to a wider range of sites.** In some countries, areas of water deeper than 50 meters may have higher mean wind speeds or be located closer to population centers than areas of shallower water. For some countries, such as those with a narrow continental shelf, floating foundations offer the only opportunity for large-scale OSW deployment. The Philippines certainly benefits in this regard, with many more areas of good wind resource in deep water than shallow, including sites close to Manila.
- **Floating OSW allows for more onshore construction work.** Turbines can be fully installed on foundations in port. This offers the long-term prospect of reduced cost and risk, as offshore activities typically have a cost and risk premium. It also enables the use of low-cost, readily available installation vessels, rather than the use of bespoke jack-up installation vessels.
- **Floating foundation hull design is less dependent on ground conditions.** This increases the potential for standardization of foundation designs, enabling further cost reduction.
- **Floating foundations are less susceptible to seismic activity and associated extreme wave events.** Due to the dynamic separation between foundation and seabed, and the ability of the foundation to float, early experience in Japan has been of a good resistance to extreme events. They can however be more susceptible to extreme wind speeds associated with typhoons (for example), depending on design.
- **Floating OSW generally has less-invasive activity on the seabed during installation.** This potentially reduces aspects of local environmental impact. This is especially relevant for the Philippines, with many environmentally sensitive habitat especially in shallow water.

Additional challenges beyond fixed offshore wind

- **Higher costs in early years.** Fixed OSW has seen significant cost reduction over time, as designs are optimized for greater volume and the application is better understood. The same is anticipated in floating OSW, based on early experience. A risk to the Philippines is that floating OSW costs take longer to reduce than expected, thereby delaying deployment (or increasing cost).
- **Have to build new confidence in the technology and supply chain.** Many aspects of the technology and supply chain are almost the same, but floating foundation hulls, mooring systems, installation and major component replacements and the use of dynamic subsea cables are key areas of difference.

  - Steel and concrete hull designs and a range of mooring systems have been used in oil and gas and other marine applications, but not at the volumes that will be used in OSW, challenging supply chain growth especially later in the decade.
  - The challenge for replacement of major components is that in fixed OSW, relative movement between a jack-up vessel crane hook and turbine tower top is already significant in medium wind speeds. The dynamic challenge of synchronizing movement of a floating vessel crane hook with a floating turbine tower top is significantly greater, giving rise to two possible strategies:
    - Mechanically and electrically disconnect the turbine and its foundation and tow it to shore for component replacement, potentially replacing the turbine straight away with a spare system, to minimize lost generating time.
    - Overcome this dynamic challenge and use a floating crane vessel.

  Typically, developers assume the former solution, with a potential future upside when (possibly at any point in a project life cycle), new solutions become available.

  - Dynamic subsea cables are used in oil and gas, and supplied by similar suppliers to in OSW, but not at the power levels needed for OSW. Practical design and testing projects have been under way for some time to address the new challenges, and early floating projects have demonstrated solutions.

  Overall, this means that developers of early projects do have to carry more technology risks, and owners and lenders will price this, but by the current pace of technology activity, much risk will have been removed before the first floating project in the Philippines.

- Some markets have an established fixed OSW pipeline of projects but no floating pipeline. This means that however fast the technology is available, the market will be delayed by the establishment and use of frameworks covering floating projects:

  - Leasing rounds need to be in different areas
  - Permitting, including ESIA, has different considerations, some of which will need precedent set through early projects
  - Power purchase, potentially to differentiate from fixed projects in markets that support both technologies.

  In the Philippines, with the first floating project anticipated in 2032 and few fixed sites available, these barriers are unlikely to have an impact.

8. MARKET VOLUME IN THE PHILIPPINES

8.1 TO DATE

The Philippines has about 0.5 GW of onshore wind capacity operating, but is at the early stage of establishing OSW, with only a handful of projects having secured Wind Energy Service Contracts and starting along the project development journey. There is now much interest, and careful management is needed to establish a strong and sustainable pipeline of successful projects.

8.2 A VISION FOR OFFSHORE WIND TO 2050

Developing an OSW project is a long-term infrastructure investment. Developing a national program of many projects needs to be considered within the context of strategic energy plans over decades. This also helps drive down the cost of energy and encourage local supply chain development, as further discussed in Sections 10 and 11.

The Philippines can accelerate OSW projects rapidly over the next few years. The success of this acceleration will depend on the clarity of the government's long-term ambition and the actions that the government takes to facilitate growth.

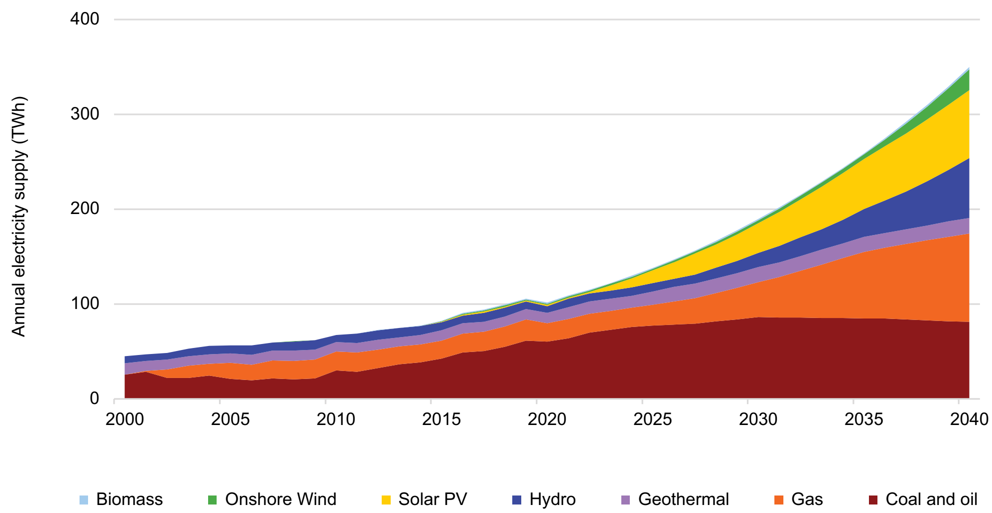
In the high growth scenario that we model, the OSW deployment rate increases to 2 GW per year by 2036, resulting in just over 20 GW operating by 2040. We assume the deployment rate then remains constant during the 2040s (at around 2 GW per year) representing a stable, mature sector. This leads to 40 GW operating capacity by 2050, delivering almost 160 TWh per year in 2050.

8.3 IN THE PHILIPPINES' NATIONAL CONTEXT

Forecast to 2040

Figure 8.1 shows how electricity demand is met by supply in the Philippines from 2000 to 2040. Historical data from 2000 to 2014 are taken from the International Energy Agency (IEA) and data from 2014 onward are provided by the Department of Energy (DOE).[5] The electricity demand forecast and how it is met by supply to 2040 uses the DOE's Clean Energy scenario, which does not include OSW. This forecast shows a significant amount of new gas generation coming online after 2030 and a large amount of coal- and oil-fired generation still operating by 2040, representing over 23 percent of electricity generation.

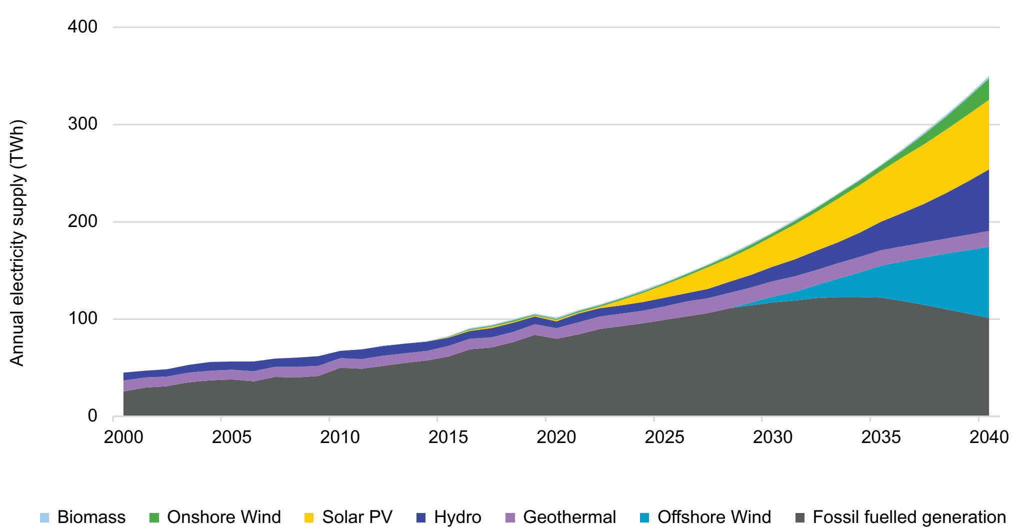
FIGURE 8.1 HISTORIC AND FORECAST ELECTRICITY SUPPLY IN THE PHILIPPINES, SPLIT BY GENERATION TYPE (WITHOUT OSW)



Source: DOE.

Figure 8.2 shows the same electricity supply forecast, but with OSW (from the high growth scenario) offsetting fossil fueled generation (the combination of coal, oil, and gas). In 2040, the 73 TWh of OSW generation reduces fossil fueled generation by 42 percent. The addition of OSW could help the Philippines accelerate its decarbonization, especially through the retiring of old coal plant, and potentially reducing the need for new construction of fossil fueled generation after 2030.

FIGURE 8.2 HISTORIC AND FORECAST ELECTRICITY SUPPLY IN THE PHILIPPINES SPLIT BY GENERATION TYPE (WITH OSW HIGH GROWTH SCENARIO)



Source: DOE, BVG Associates.

Forecast to 2050

The DOE's current Clean Energy scenario5 assumes 10 percent penetration of electric vehicles by 2040 and at least 50 percent of the electricity demand being met by renewable energy generation (equivalent to around 15 MTOE). This, however, is less than 20 percent of the Philippines' final energy consumption, meaning that, in 2040, around 75 MTOE of the Philippines' energy will still be supplied by fossil fuels. This highlights the scale of the decarbonization challenge and the need for indigenous sources of energy.

Following the recent commitments of other nations, we anticipate that by 2050 much of the Philippines' energy system will be decarbonized, through extensive use of

- Electric vehicles;
- Hydrogen as fuel for heavy transport and aviation;
- Hydrogen to provide high-grade heat in industrial applications; and
- Electricity, displacing burning of fuels for domestic energy use.

An indicative estimate of demand from decarbonization has been combined with an extrapolation of electricity demand in the Clean Energy scenario to determine the national electricity demand for 2050 that is presented in Table 8.1.[x] It is double the demand in 2040.

OSW has the potential to play an important role in the Philippines' energy transition. In 2050, the high growth scenario of 40 GW of OSW will provide 23 percent of the Philippines' electricity supply. This 40 GW, made up of 37 GW of floating and 3 GW of fixed capacity, fits comfortably within the World Bank's previously published view of 178 GW of technical potential,[xi] which includes 160 GW of floating and 18 GW of fixed capacity.[17]

Snapshots of OSW supply in 2030, 2040, and 2050 are presented in Table 8.1, reflecting the trend shown in Figure 4.1.

TABLE 8.1 ELECTRICITY SUPPLIED BY OFFSHORE WIND TO 2050 IN THE HIGH GROWTH SCENARIO

	2030	2040	2050
OSW operating capacity (GW)	2.8	20.5	40.5
Average capacity factor of operating projects (%)	37	45	47
OSW electricity production (TWh/yr)	6	73	159
National demand (TWh/yr)*	190	350	700
Percentage of electricity supplied by OSW	3	21	23

*National demand is taken from DOE for 2030 and 2040 and estimated, assuming extensive decarbonization as discussed above, for 2050.Source: BVG Associates.

The capacity factor in 2030 is based on the first two fixed projects installed up to the end of 2029 on lower-wind sites. By 2040, the average capacity factor of operating projects incorporates a number of

x Indicative demand from decarbonization is derived as follows:
- Electrified aviation, electrified diesel (mainly heavy vehicle transport), electrified gasoline (mainly electric light vehicle transport) extrapolated from IEA oil final consumption by product, using jet kerosine, gas/diesel, and motor gasoline (see https://www.iea.org/data-and-statistics/data-browser?country=PHILIPPINE&fuel=Energy%20consumption&indicator=OilProductsCons).
- Electrified heat (cooking and heating water) assumed to be 70 percent of household energy consumption, refer DOE Clean Energy scenario.

xi This technical potential includes all locations with wind speed above 7 m/s at height of 100 meters, water depth less than 1,000 meters, and with minimum size 10 km^2. It does not factor in environmental, social, and technical considerations.

floating projects on higher-wind sites as well as the use of larger turbines. The calculation of capacity factors is explained in Section 10.

Based on our understanding of social and economic constraints and future demand, we believe 20 GW and 40 GW offer a realistic, conservative vision for OSW in the Philippines by 2040 and 2050.

With the Philippines' other renewables resources, OSW can help the Philippines take big steps to decarbonizing its power sector, as it continues to grow its economy and transitions toward a zero-carbon future and meeting its international obligations. About 23 percent of electricity production in the Philippines comprises about two-thirds of Wind Europe's vision for the whole of Europe in 2050.[18] The above discussion is based on annual supply and demand balances. As discussed in Section 7.2, we recognize that OSW is a variable renewable energy technology, with a cost to managing that variability.

We also recognize that the energy transition will involve other vectors beyond electricity. There is much work under way, exploring the synergies between OSW and green hydrogen production for internal use or export. Hydrogen offers further opportunities for the Philippines to benefit from its valuable natural OSW resource. An additional advantage of using electricity to charge electric vehicles and to produce hydrogen that can be stored and then used as a transport or industrial fuel is that these applications introduce significant volumes of storage into the energy system. Critical to these applications are

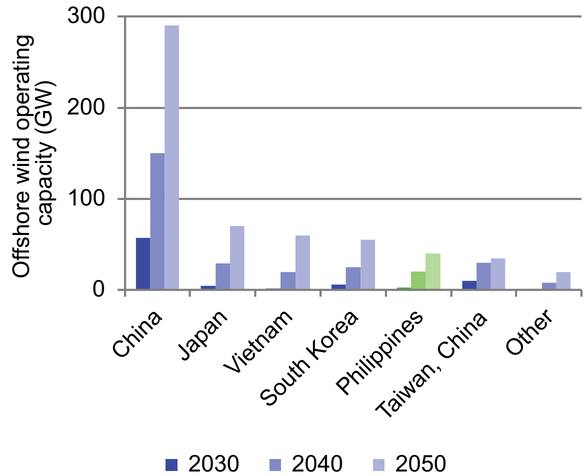
- The development of faster-charging, higher energy storage batteries with lower mass and cost; and
- The development of lower cost electrolyzers and hydrogen distribution systems.
- With the global focus on such technologies, it is highly likely that the Philippines will be able to benefit from them as it accelerates decarbonization in the 2030s and 2040s.

8.4 WITHIN EAST AND SOUTHEAST ASIA

Within East and Southeast Asia, the other key OSW markets are likely to be China, Japan, Republic of Korea, Taiwan, China, and Vietnam. Although there is much uncertainty, it is reasonable to assume growth in OSW following the trend shown in Figure 8.3, with the Philippines overtaking Taiwan, China in the 2040s.

These markets, each more advanced than the Philippines, offer the opportunity to access what will be a mature regional supply chain by the late 2020s, in both fixed and floating OSW. It also enables the Philippines to take the benefit of technology solutions relevant to regional challenges, such as typhoons and high seismic activity.

FIGURE 8.3 INDICATIVE FORECAST OF CUMULATIVE OPERATING OFFSHORE WIND CAPACITY IN HIGH GROWTH SCENARIO IN THE PHILIPPINES AND IN THE REST OF EAST ASIA END 2030, 2040, AND 2050

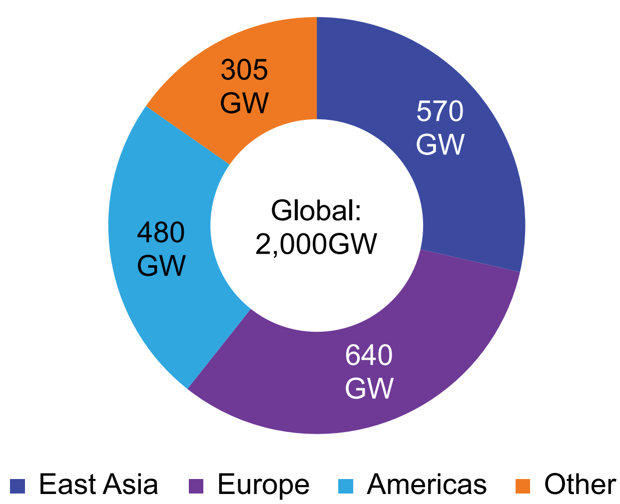


Source: BVG Associates.

8.5 GLOBALLY

The almost 600 GW of OSW capacity in East Asia in 2050 fits within a wind industry vision[19] of 2 TW in 2050, as shown in Figure 8.4. This 2 TW of OSW capacity is expected to deliver 7,700 TWh per year, or about 14 percent of global electricity demand.

FIGURE 8.4 INDICATIVE FORECAST OF CUMULATIVE OPERATING OFFSHORE WIND CAPACITY GLOBALLY END 2050



Source: BVG Associates.

8.6 OFFSHORE WIND ENERGY PRODUCTION AND COST DATA

Table 8.2 and Table 8.3 show key data for both scenarios for the period 2028 to 2050, supporting calculations throughout the study. It combines fixed and floating project data (costs, production) that were calculated separately. We assume no generation from projects in the year of installation. Note that data relate to scenarios, with smooth trends shown over time. In reality, for new projects the project sizes, costs, lifetimes, cost of money, and nominal capacity factors will vary from this trend. In addition, actual generation for operating projects will vary based on year-by-year mean wind speeds.

Levelized cost of energy (LCOE) and capacity factor for projects installed in the year are computed by linear interpolation between calculated points in 2028, 2033, and 2038 and combining fixed and floating projects, where appropriate. See Section 10 for a detailed description of how these values have been calculated. For floating LCOE, a 2 percent year-on-year reduction is assumed after 2038 in the low growth scenario and 3 percent is assumed for the high growth scenario, extending the trends seen in 2030s. Analysis of the innovation and cost reduction potential of OSW to 2040 and beyond suggests that this is valid. In the same way, a 0.5 percent year-on-year increase in capacity factor is assumed after 2038 in both scenarios.

Annual energy production (AEP) is the sum across all wind farms operating in the year, considering the different capacity factors for each annual capacity installed. Cumulative energy production is the sum of this, over time. Over time, capacity factors are assumed to increase for two reasons; (1) as the industry transitions from fixed to floating OSW, projects are gradually installed further offshore in areas of higher wind resource, and (2) turbine technology is expected to continue improving over the coming decades and this will lead to performance increases.

Annual net generation cost-benefit is the annual cost of generation from traditional fossil fuel technology in the year, minus the sum across all wind farms operating in the year of energy production multiplied by LCOE, considering the different energy production and LCOE for each annual capacity installed (see Section 7.1). Cumulative net generation cost-benefit is the sum of this, over time.

TABLE 8.2 ENERGY PRODUCTION AND COST DATA FOR LOW GROWTH SCENARIO

Year	Annual installed capacity (GW)	Cumulative operating capacity at end of year (GW)	LCOE for projects installed in the year (US$/MWh)	Capacity factor for projects installed in the year (%)	Annual energy production (TWh)	Cumulative energy production (TWh)	Annual net generation cost-benefit (US$, billions)	Cumulative net generation cost-benefit (US$, billions)
2028	0.8	0.8	86	37	0.0	0.0	0.0	0.0
2029		0.8			2.6	2.6	0.0	0.0
2030	0.8	1.6	77	37	2.6	5.1	0.0	-0.1
2031		1.6			5.2	10.3	0.0	-0.1
2032		1.6			5.2	15.5	0.0	-0.1
2033		1.6			5.2	20.7	0.0	-0.2
2034	0.8	2.4	78	46	5.2	25.9	0.0	-0.2
2035		2.4			8.4	34.3	0.0	-0.3
2036		2.4			8.4	42.7	0.0	-0.3
2037		2.4			8.4	51.1	0.0	-0.3
2038	0.8	3.2	63	46	8.4	59.5	0.0	-0.4
2039		3.2			11.7	71.1	0.0	-0.3
2040		3.2			11.7	82.8	0.0	-0.3

Year	Annual installed capacity (GW)	Cumulative operating capacity at end of year (GW)	LCOE for projects installed in the year (US$/MWh)	Capacity factor for projects installed in the year (%)	Annual energy production (TWh)	Cumulative energy production (TWh)	Annual net generation cost-benefit (US$, billions)	Cumulative net generation cost-benefit (US$, billions)
2041		3.2			11.7	94.4	0.0	-0.3
2042	0.8	4.0	58	47	11.7	106.1	0.0	-0.3
2043		4.0			15.0	121.0	0.1	-0.2
2044		4.0			15.0	136.0	0.1	0.0
2045		4.0			15.0	151.0	0.1	0.1
2046	0.8	4.8	54	48	15.0	165.9	0.1	0.2
2047		4.8			18.3	184.3	0.2	0.4
2048		4.8			18.3	202.6	0.2	0.6
2049		4.8			18.3	221.0	0.2	0.8
2050	0.8	5.6	50	49	18.3	239.3	0.2	1.1

Note: Data are smoothed compared to real-life situation, as explained above.

TABLE 8.3 ENERGY PRODUCTION AND COST DATA FOR HIGH GROWTH SCENARIO

Year	Annual installed capacity (GW)	Cumulative operating capacity at end of year (GW)	LCOE for projects installed in the year (US$/MWh)	Capacity factor for projects installed in the year (%)	Annual energy production (TWh)	Cumulative energy production (TWh)	Annual net generation cost-benefit (US$, billions)	Cumulative net generation cost-benefit (US$, billions)
2028	0.8	0.8	86	37	0.0	0.0	0.0	0.0
2029	1.0	1.8	81	37	2.6	2.6	0.0	0.0
2030	1.0	2.8	82	39	5.8	8.4	-0.1	-0.1
2031	1.2	4.0	81	42	9.3	17.6	-0.1	-0.2
2032	1.4	5.4	82	46	13.6	31.2	-0.1	-0.3
2033	1.6	6.9	71	46	19.1	50.3	-0.1	-0.4
2034	1.8	8.7	67	47	25.5	75.8	-0.1	-0.5
2035	1.9	10.6	63	47	32.7	108.5	0.0	-0.6
2036	2.0	12.6	58	47	40.5	149.0	0.1	-0.5
2037	2.0	14.6	54	47	48.7	197.7	0.2	-0.2
2038	2.0	16.6	50	47	56.9	254.6	0.4	0.2
2039	2.0	18.6	48	47	65.2	319.7	0.7	0.9
2040	2.0	20.5	47	48	73.4	393.2	1.0	1.9
2041	2.0	22.5	45	48	81.8	474.9	1.2	3.1
2042	2.0	24.5	44	48	90.1	565.1	1.5	4.6
2043	2.0	26.5	43	48	98.5	663.6	1.9	6.5
2044	2.0	28.5	41	48	107.0	770.6	2.2	8.7
2045	2.0	30.5	40	49	115.5	886.0	2.6	11.3
2046	2.0	32.5	39	49	124.0	1,010.0	3.0	14.3
2047	2.0	34.5	38	49	132.6	1,142.6	3.4	17.6
2048	2.0	36.5	37	49	141.2	1,283.8	3.8	21.4
2049	2.0	38.5	36	50	149.8	1,433.6	4.2	25.7
2050	2.0	40.5	34	50	158.5	1,592.2	4.7	30.4

Note: Data are smoothed compared to real-life situation, as explained above.

9. SPATIAL MAPPING

9.1 PURPOSE

The purpose of this section is to present an overview of the publicly available spatial data relating to environmental, social, and technical considerations that may affect prospective OSW development in the Philippines and to derive OSW development zones.

The maps presented are intended to inform readers of the key considerations and site characteristics in areas potentially suitable for OSW development.

Only a preliminary analysis is carried out and additional datasets need to be considered when developing a marine spatial plan or developing an OSW project.

9.2 METHOD

In the sections below, we present the following:

- Technical potential for OSW in the Philippines based on a simplified assessment
- Environmental, social, and technical considerations
- Environmental and social restrictions and exclusions, based on these considerations
- LCOE
- Potential OSW development zones, based on all of the above.

The following subsections describe the methods used to derive the results in each of these areas.

Technical potential

The analysis was originally described and published in the *Going Global: Expanding Offshore Wind to Emerging Markets* report,[20] which estimated the Philippines 'technical potential' to be 18 GW for fixed foundation and 160 GW for floating foundation OSW technologies. See this document for full methodology.

Technical potential is defined as the maximum possible installed capacity as determined by wind speed and water depth. Mean wind speeds (at height of 100 meters) exceeding 7 meters per second are considered viable for OSW, and water depths of up to 50 meters and up to 1,000 meters are considered viable for fixed and floating foundations, respectively. The datasets used in this analysis are listed under technical considerations in Table 9.1.

The analysis of technical potential does not take into account other factors that could influence the planning and siting of OSW projects including environmental, social, and economic considerations.

Environmental, social, and technical considerations

The environmental, social, and technical considerations mapping provides additional context about the known locations of environmentally sensitive areas and important land and coastal infrastructure. Most datasets identified are global datasets which include data covering the Philippines. Table 9.1 provides a list of the spatial datasets and sources that were included in this considerations mapping activity.

TABLE 9.1 SPATIAL DATA LAYERS USED IN THE ANALYSIS

Data layer	Notes	Data Source	Reference
ENVIRONMENTAL CONSIDERATIONS			
Marine protection areas	Areas legally protected under the National Integrated Protected Area System (NIPAS) Act. Includes Locally Managed Protected Areas (LMPAs) as listed below.	DENR-BMB	https://data.unep-wcmc.org/datasets/44
Critical habitats	Areas of known habitats of threatened species, designated under Wildlife Resources Conservation and Protection Act No. 9147 (the Wildlife Act).	DENR-BMB	https://data.unep-wcmc.org/datasets/44
Key Biodiversity Areas (including alliance for zero extinction sites and Important Bird Areas [IBA])	Areas of international importance in terms of biodiversity conservation.	IBAT	https://www.ibat-alliance.org/sample-downloads?tab=gis-downloads&anchor_id=resource-header
Ramsar sites	Wetlands of international importance that have been designated under the criteria of the Ramsar Convention on Wetlands for containing representative, rare or unique wetland types, or for their importance in conserving biological diversity.	IBAT	http://ihp-wins.unesco.org/layers/geonode:sites
Important Marine Mammal Areas (IMMAs)	IMMAs are habitats important to marine mammal species that have the potential to be delineated and managed for conservation.	Tethys Research Institute	https://www.tethys.org/
UNESCO World Heritage Natural Sites	The natural World Heritage spatial data are updated annually in the World Database on Protected Areas (WDPA), after the World Heritage Committee meeting, hosted on Protected Planet. The current version is August 2017.	UNEP	http://www.unep-wcmc.org
UNESCO-MAB biosphere reserves	The Man and the Biosphere (MAB) program is an intergovernmental scientific program that aims to establish a scientific basis for enhancing the relationship between people and their environments. It combines the natural and social sciences with a view to improving human livelihoods and safeguarding natural and managed ecosystems, thus promoting innovative approaches to economic development that are socially and culturally appropriate and environmentally sustainable.	UNESCO	http://ihp-wins.unesco.org/layers

Data layer	Notes	Data Source	Reference
Coral reefs	Important natural habitat.	Allen Coral Atlas (via TBC)	https://allencoralatlas.org/resources/
Seagrass beds	Important natural habitat.	Allen Coral Atlas (via TBC)	https://allencoralatlas.org/resources/
Mangrove forests	Important natural habitat.	UNEP-WCMC	https://data.unep-wcmc.org/datasets/45
Locally managed marine protected areas	The Biodiversity Management Bureau (BMB) of the DENR implements a Coastal and Marine Ecosystem Management Program (CMEMP), which includes all coastal and marine areas of the Philippines. LMPAs that are designated by the Fisheries Code include fish reserves, sanctuaries, and refuges; seagrass sanctuaries; marine parks; and marine reserves, sanctuaries, and refuges. LMPAs include all waters within a municipality that are not included in protected areas under the NIPAS Act.	Philippines geo-portal	https://www.geoportal.gov.ph/
Ecologically or biologically significant marine areas	Internationally agreed marine areas of importance.	CDB	http://www.cbd.int/
Cartilaginous fish	Areas of sensitive marine species, specifically sharks, rays, and chimaeras.	TBC National Stock Assessment Program (NSAP) under Department of Agriculture Bureau of Fisheries and Aquatic Resources (DAR-BFAR) Sharks Assessment Report dataset 2009–2016.	See references for KBAs and MPAs
Endemic bird areas (EBAs)	Areas of overlapping breeding ranges of restricted range bird species.	BirdLife International Data Zone.	http://datazone.birdlife.org/eba/
SOCIAL CONSIDERATIONS			
UNESCO World Heritage Sites	Cultural and/or natural heritage sites with outstanding universal value to humanity. No sites identified within the Philippines analysis area.	UNESCO	http://ihp-wins.unesco.org/layers/worldheritagesites:geonode:worldheritagesites
Fishing ports	Municipal and regional fishing ports.	Philippines geo-portal	https://www.geoportal.gov.ph/
Landscape and seascape	Sites with protected status due to their landscape or seascape value.	BMB, DENR, Philippine Government	Manually digitized from information in - https://www.denr.gov.ph/images/DENR_Publications/PA_Guidebook_Complete.pdf
Tourism areas	Tourism ports development pipeline.	DOTR	DOTR
TECHNICAL CONSIDERATIONS			
Airports	Regions around airports may need to be avoided to reduce radar impacts.	Openflights 2020	https://openflights.org/data.html
Exclusive economic zones (EEZ)	Internationally recognized marine boundaries.	Marine Eco Regions	https://www.marineregions.org/
Extreme wind speeds	Used for information.	PREVIEW Global Data Risk Platform	https://preview.grid.unep.ch/

Data layer	Notes	Data Source	Reference
Mean wind speed	Used to determine AEP and LCOE.	The Global Wind Atlas v3.0, released in 2019 (Danish Technical University [DTU] and the World Bank Group [WBG])	https://globalwindatlas.info/
Military bases	Locations of military bases in the Philippines.	Arup/Google Earth	Manually digitized from Google Earth
Offshore oil and gas activity	Locations of offshore oil and gas activity.	Philippines geo-portal	https://www.geoportal.gov.ph/
Ports	Locations and size of ports.	Humdata/Philippines geo-portal	https://www.geoportal.gov.ph/
Seismic activity	Used for information.	PREVIEW Global Data Risk Platform	https://preview.grid.unep.ch/
Shipping density	The raster layers were created using International Monetary Fund's (IMF) analysis of hourly AIS positions received between January 2015 and February 2021 and represent the total number of AIS positions that have been reported by ships in each grid cell with dimensions of 0.005 degree by 0.005 degree (approximately a 500 meters × 500 meters grid at the Equator). The AIS positions may have been transmitted by both moving and stationary ships within each grid cell; therefore, the density is analogous to the general intensity of shipping activity.	World Bank	https://datacatalog.worldbank.org/search/dataset/0037580/Global-Shipping-Traffic-Density
Undersea cables	Datasets include official submarine cable system name, cable system length in kilometers, and landing points. Additional information such as the owners of the cable systems can be found on www.subamrinecablemap.com. The routes of the cables do not accurately reflect the exact route taken by each cable but give an indication of approximate location.	Submarine Cable Map	
Water depth	Used to determine areas of fixed/floating foundations and as input to the LCOE model.	The General Bathymetric Chart of the Oceans	https://www.gebco.net/data_and_products/gridded_bathymetry_data/

No reliable datasets were obtained for the following social and technical considerations:

- Aggregate and material extraction areas
- Commercial fisheries
- Marine aquaculture
- Military practice and danger areas
- Offshore disposal sites
- Wrecks and historic offshore sites.

Future spatial analysis as part of a country-scale marine spatial plan will need to consult stakeholders, identify relevant existing data, and gather data on prioritized biodiversity values[xii] to better understand the Philippines' onshore, coastal, and offshore ecosystems. It is likely that data gaps in relation to the biodiversity baseline will require additional field surveys to be completed according to GIIP to inform spatial planning, site selection, and project-level ESIA.

Environmental, social, and technical considerations

For defining potential OSW development zones, the range of environmental, social, and technical considerations are reduced to

- An environmental restrictions layer;
- An environmental exclusions layer; and
- Maps of map of social and technical considerations, with discussion about potential buffer zones. A summary of this content is provided in Section 14.

The method for reducing to environmental restriction and exclusion layers is presented in Appendix. Each environmental, social, and technical consideration described in Section 14 is designated either a restriction or exclusion in that section.

Levelized cost of energy

The site parameters that have the most influence on cost of energy are as follows:

- Wind speed
- Water depth
- Distance to construction port
- Distance to operation port
- Distance to grid.

These site parameters were used along with an assumed set of reference project characteristics, as shown in Table 9.2 (consistent with the high growth scenario in Section 10), and functions of typical project costs from BVG Associates as inputs into a technoeconomic model which was used to estimate the headline spatial distribution of the relative LCOE for a reference project in the Philippines' waters. The analysis is fully compatible with the LCOE trajectories for typical projects presented in Section 10.

xii These aspects are likely to include birds, marine mammals, fish, benthic communities, bats, turtles, and onshore receptors.

The analysis is detailed, but not as sophisticated as is carried out for an actual OSW project, involving years of detailed design and optimization.

TABLE 9.2 ASSUMED CHARACTERISTICS OF THE REFERENCE WIND FARM PROJECT USED IN THE MODELLING

<table>
<tr><th></th><th>Fixed</th><th>Floating</th></tr>
<tr><td>Scenario</td><td colspan="2">High</td></tr>
<tr><td>Year of installation</td><td colspan="2">2033</td></tr>
<tr><td>Turbine rating (MW)</td><td colspan="2">20</td></tr>
<tr><td>Turbine rotor diameter (meter)</td><td colspan="2">250</td></tr>
<tr><td>Turbine hub height (meter)</td><td colspan="2">147</td></tr>
<tr><td>Project size (MW)</td><td colspan="2">1,000</td></tr>
<tr><td>Lifetime (years)</td><td colspan="2">32</td></tr>
<tr><td>Distance from grid (offshore) (kilometer)</td><td>20</td><td>40</td></tr>
<tr><td>Distance from grid (onshore) (kilometer)</td><td>20</td><td>0</td></tr>
</table>

The wind speed and water depth spatial datasets used were the same as for the technical potential mapping.

We calculated travel distance from the construction ports listed in Section 19 and assumed distance to operations port as (distance to nearest shore^2 + 20 km2)$^{1/2}$, recognizing that there are many potential operations ports.

We constrained water depth to less than 1,000 meters to rule out the most challenging of the floating OSW sites. We assumed floating foundations for sites with water deeper than 50 meters. In practice, the cutoff between fixed and floating depths will be determined on a project-by-project basis.

We constrained distance to shore to less than 200 kilometers to rule out sites where novel transmission infrastructure or alternative energy conversion would be needed. This was also the limit of the wind speed dataset.

Potential offshore wind development zones

To support the long-term development of OSW in the Philippines, a strategic approach to OSW and transmission network development will be needed. In support of this, we have derived six potential OSW development zones showing best potential for OSW.

When defining these zones, we considered the following environmental, social, and technical considerations:

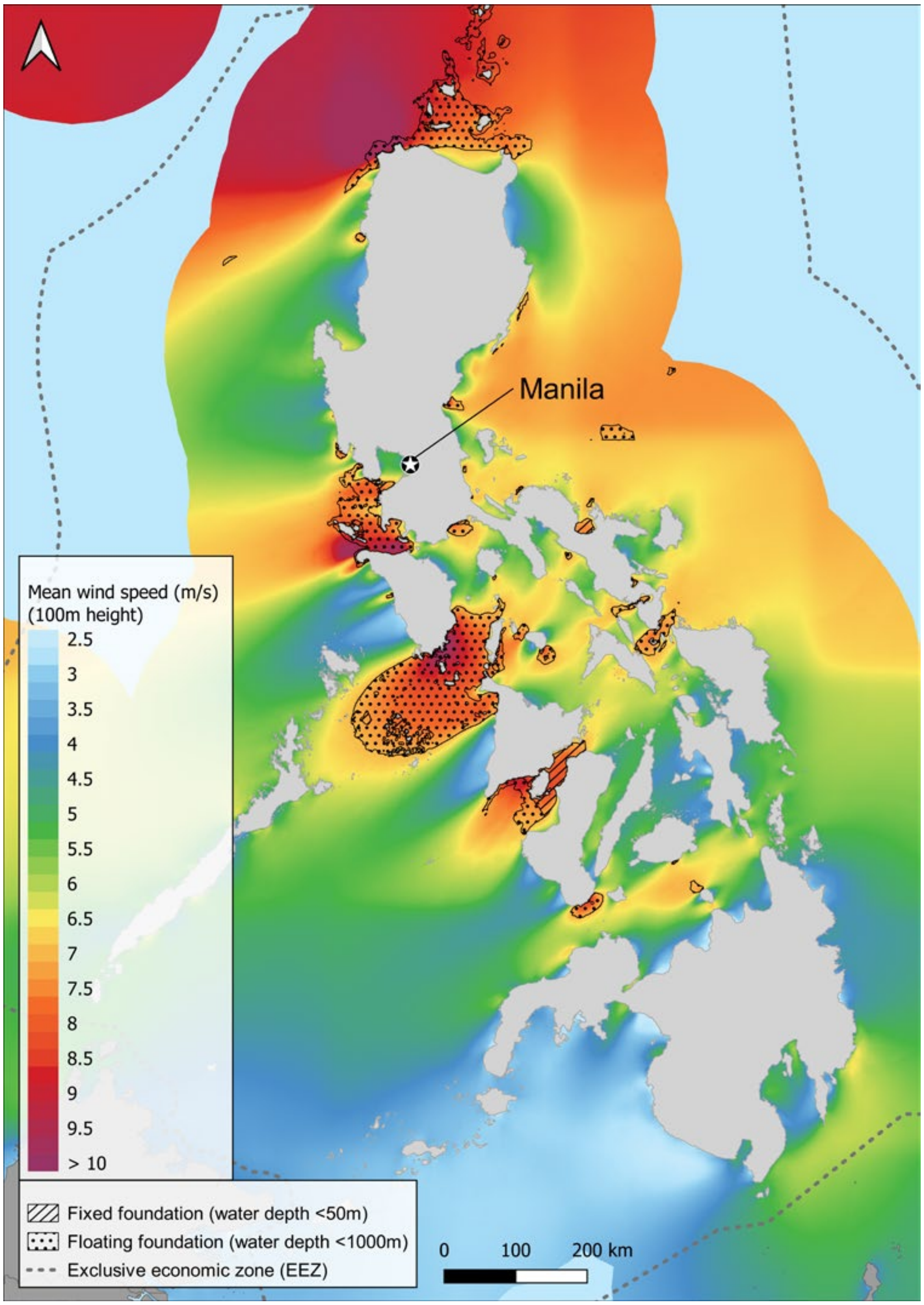
- Exclusions and restrictions based on biodiversity, social, and technical considerations (Appendix)
- High shipping density (greater than 1 passage per hour through a given 5 km^2 area)
- Subsea cable routes (with a 1 kilometer buffer)
- Minimum distance from shore (assumed to be 1 kilometer)
- Maximum depth (we used 1,000 meters as the maximum depth considered for floating foundations up to 2040s.

9.3 RESULTS

Technical potential

The technical potential is shown in Figure 9.1.

FIGURE 9.1 OFFSHORE WIND TECHNICAL POTENTIAL IN THE PHILIPPINES



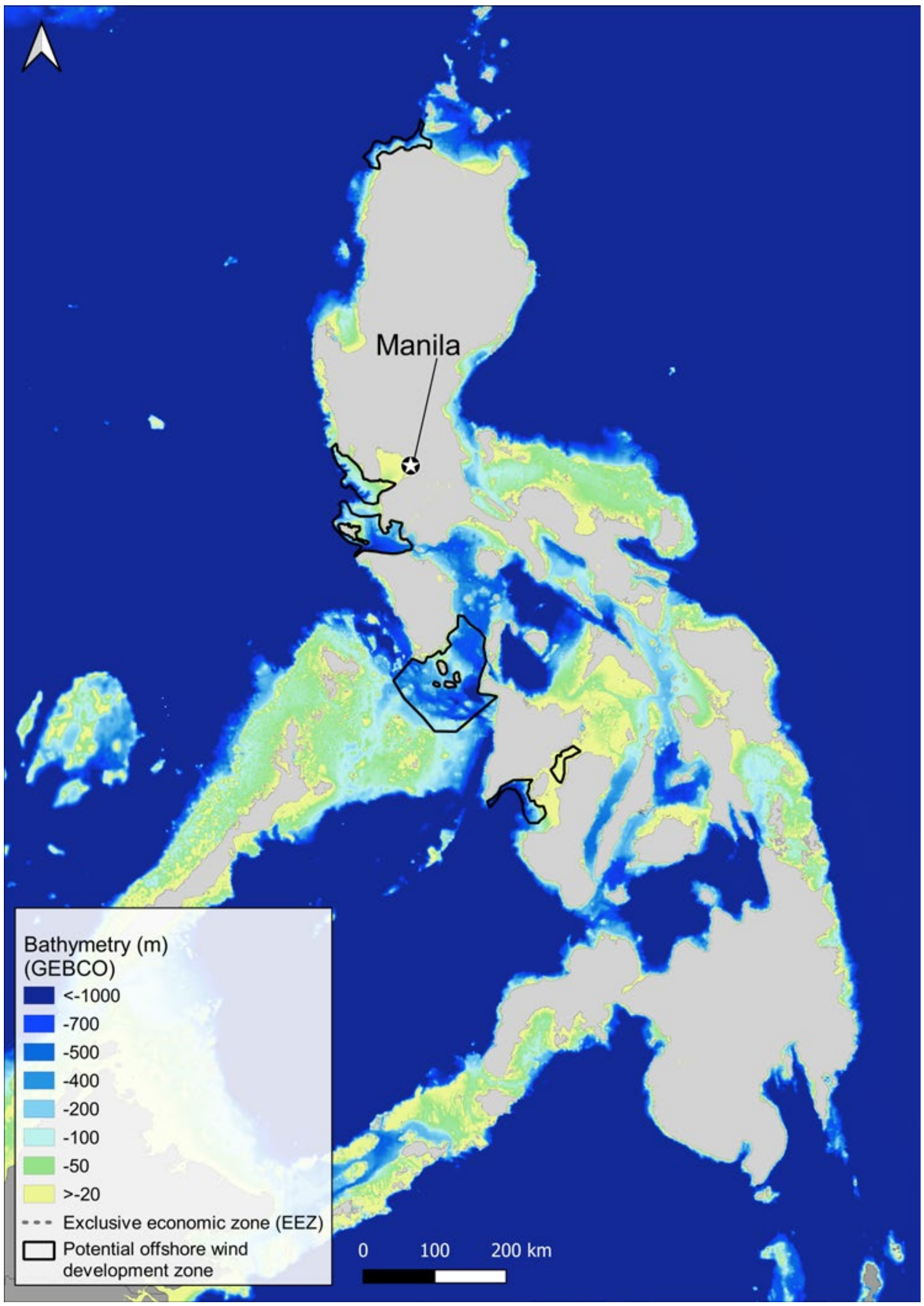
Source: World Bank Group and ESMAP.

Environmental, social, and technical considerations

Water depth

Figure 9.2 shows water depth in the Philippines and in combination with Figure 9.1, it shows there are few areas of shallow water, coupled with good wind resource, pointing to the need for floating projects.

FIGURE 9.2 WATER DEPTH IN THE PHILIPPINES



Source: see Table 9.1.

Shipping densities

Shipping routes are important to consider when siting OSW projects. Larger vessels, in particular, cannot pass through an OSW farm and need to chart a course a safe distance away from projects. Smaller vessels may be able to transit through a wind farm but there is a risk of collision with the offshore structures. A navigational risk assessment needs to be carried out, including consultation with the Philippines' maritime authorities and shipping.

Extreme wind speeds

Extreme wind speeds are an important consideration in the planning and design of OSW projects in a number of emerging markets, as they exceed normal design limits. This has not been the case in most established markets. The key challenge for wind farms seeing high storm wind speeds (above 70 m/s, as International Electrotechnical Commission [IEC] Class 1 turbines are designed for) is the LCOE impact of providing resistance to such conditions.

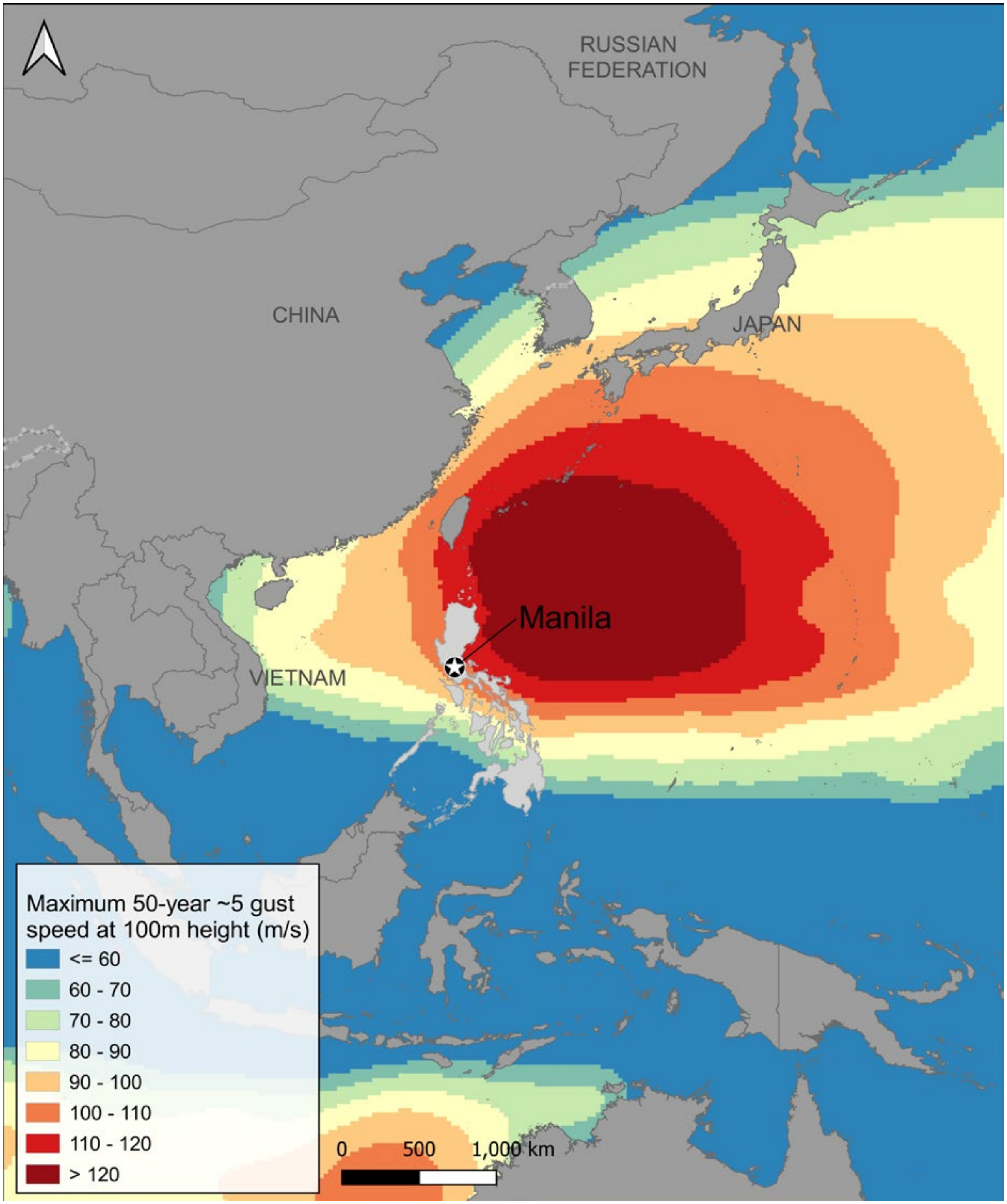
Some wind turbine suppliers seek to minimize loads through active yaw and pitch control, requiring grid power (or long-term battery backup of auxiliary systems). Others uprate blade and other structural component strength. Others seek to push existing materials somewhat further, by applying arguments regarding certainty of material (especially composite) quality. It is likely that in time, design for early projects (for example in Taiwan, China) will drive optimum solutions that can be used elsewhere and that for many sites the LCOE impact will be in the range of 2–10 percent.

The IEC has included an additional wind class T relating to typhoons, with extreme design gust wind speed of 80 m/s and some turbines are already certificated to this class by independent certification bodies. Turbines can be certificated against any stated wind conditions, as long as the turbine supplier can convince the independent certification body. In time, it is likely that higher design gust wind speeds will be covered, but at increased turbine cost and/or reduced AEP.

Figure 9.3 shows the maximum approximately 5 second gust wind speeds around the Philippines using data from the PREVIEW Global Data Risk Platform.[22] Northern waters are more susceptible to higher wind speeds, whereas southern waters are at lower risk. All of the potential OSW development zones are shown to have extreme wind speeds above 70 m/s.

This means that it is likely that typhoon class wind turbines will be needed in many locations, but extreme wind speeds may make development in the North and East too expensive and high risk, with extreme wind speeds of over 110 m/s. It may be that local measurement and forecasting could reduce anticipated extreme wind speeds, as the dataset used is broad.

FIGURE 9.3 MAXIMUM 50-YEAR GUST SPEED AT HEIGHT OF 100 METERS IN EAST ASIA



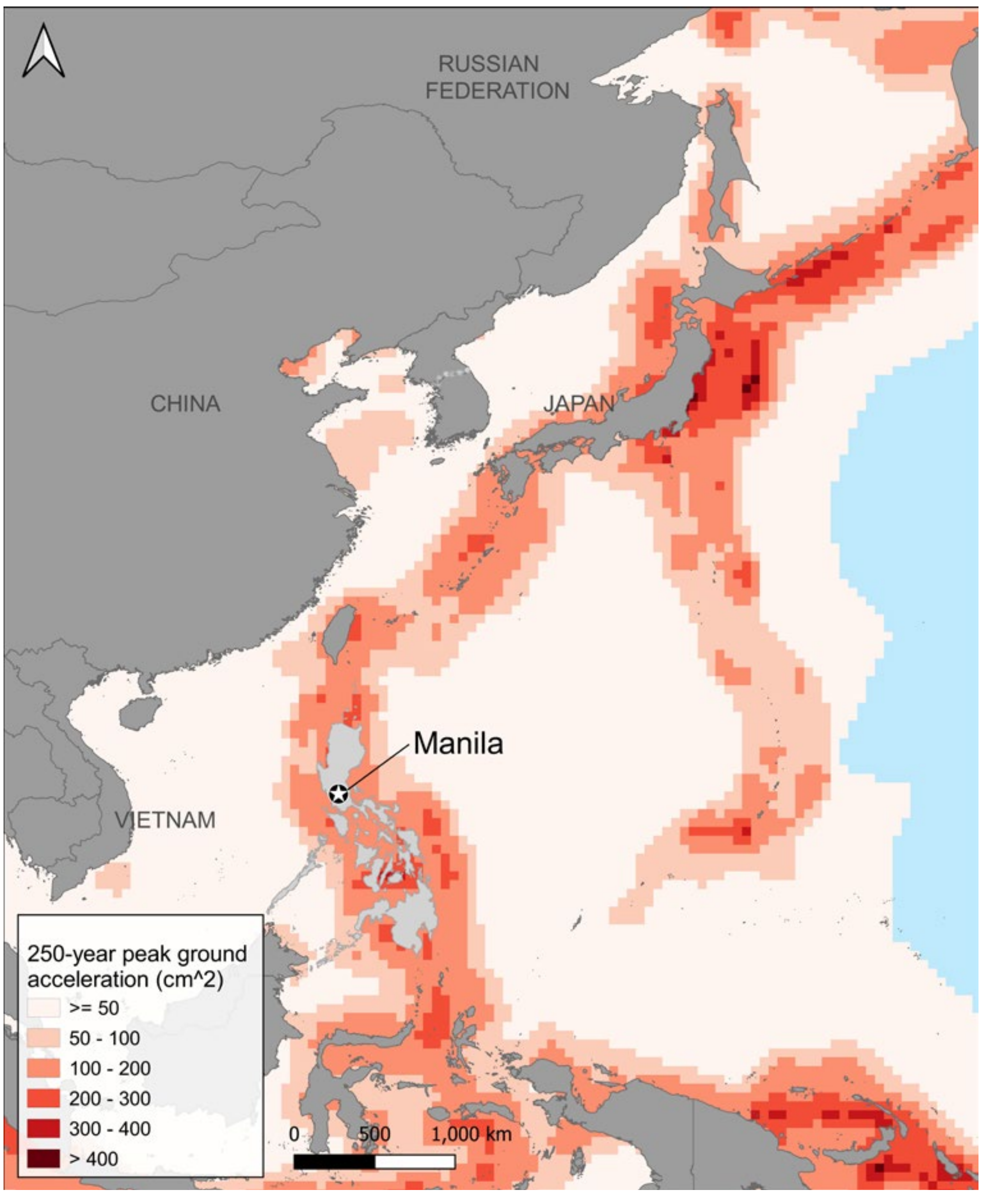
Source: see Table 9.1.

Seismic activity

The key challenge of seismic activity relates to foundation and tower. Monopiles are seen as the most susceptible, followed by jackets, then floating foundations. Both ground accelerations and resulting waves are important considerations. Early OSW experience in Japan with regard to floating foundation survival of earthquake and resulting wave resistance has been positive. In the Philippines, the key challenge would seem to be for fixed projects. See Figure 9.4, again using data from the PREVIEW Global Data Risk Platform.[22]

Related to seismic and also volcanic activity is the risk of tsunamis. This has not yet been investigated, but should be included in future work, as discussed in Section 9.5.

FIGURE 9.4 MAP OF GROUND ACCELERATION (EARTHQUAKE RISK) IN EAST ASIA



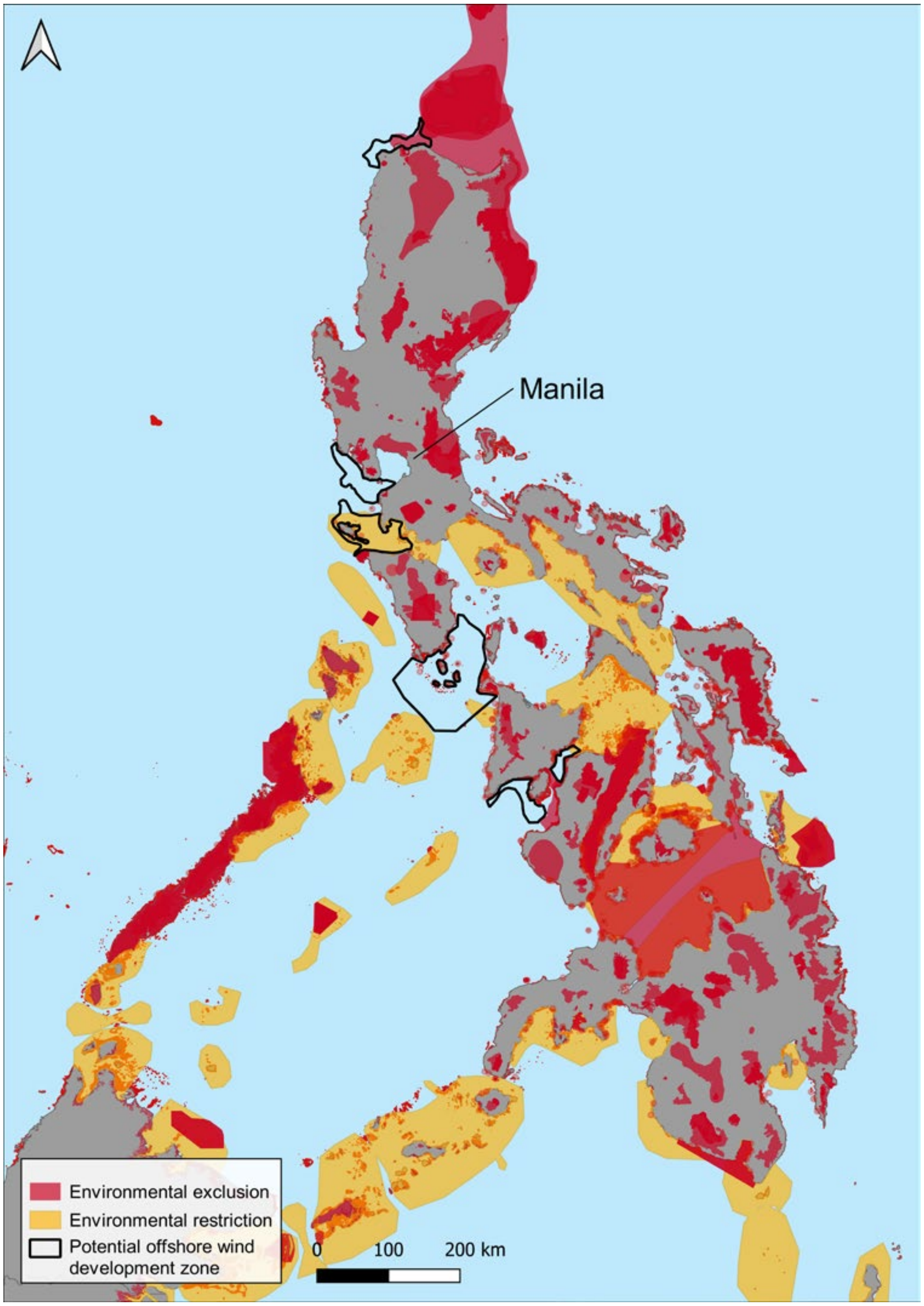
Source: see Table 9.1.

Environmental, social, and technical considerations

Environmental restrictions and exclusions

Figure 9.5 shows environmental restrictions and exclusions in the Philippines.

FIGURE 9.5 ENVIRONMENTAL RESTRICTIONS AND EXCLUSIONS IN THE PHILIPPINES

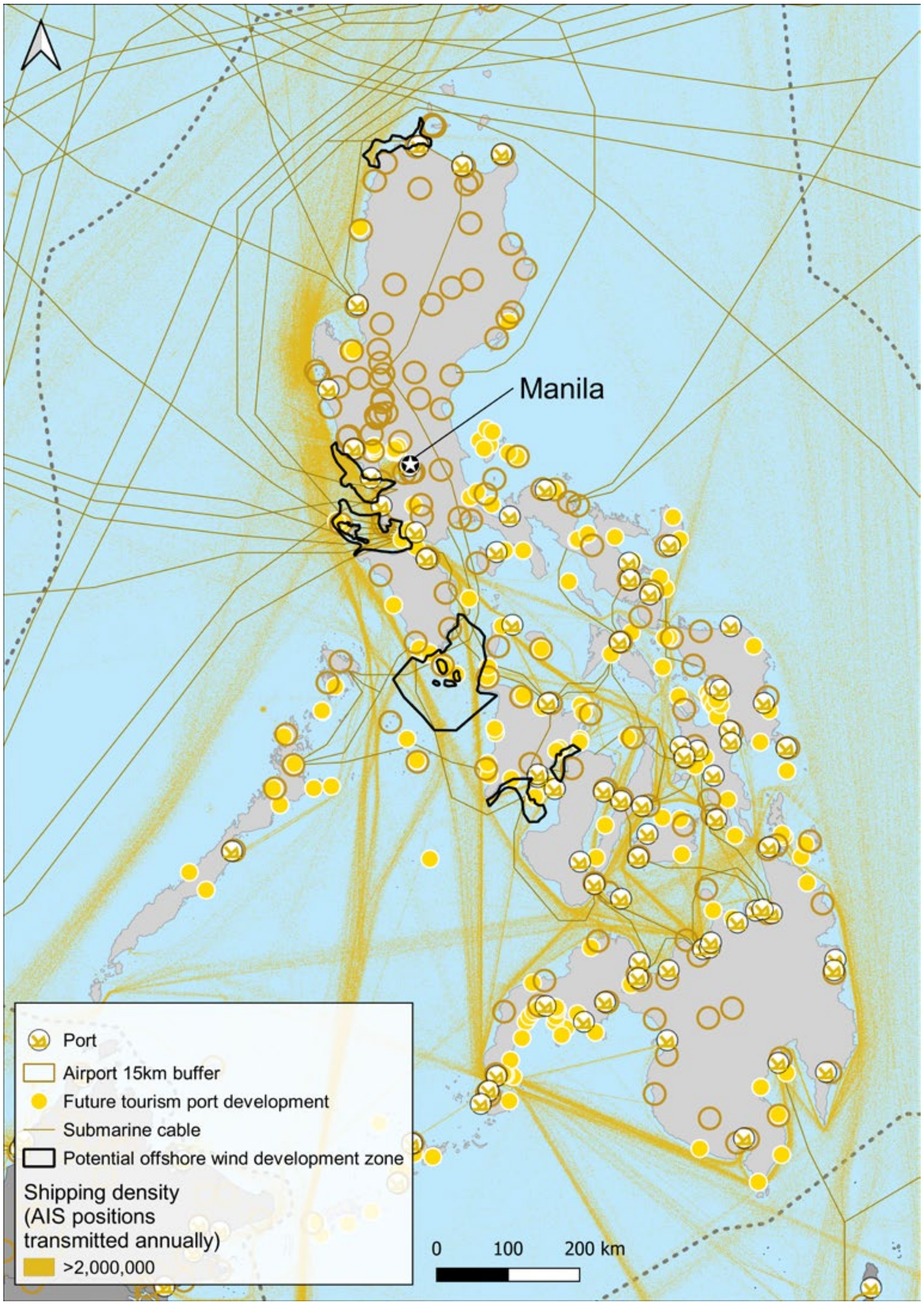


Source: see Table 9.1.

Social and technical considerations

Figure 9.6 shows social and technical considerations in the Philippines. Unlike for environmental considerations, further work is required to reduce these down to restrictions and exclusions.

FIGURE 9.6 SOCIAL AND TECHNICAL CONSIDERATIONS IN THE PHILIPPINES



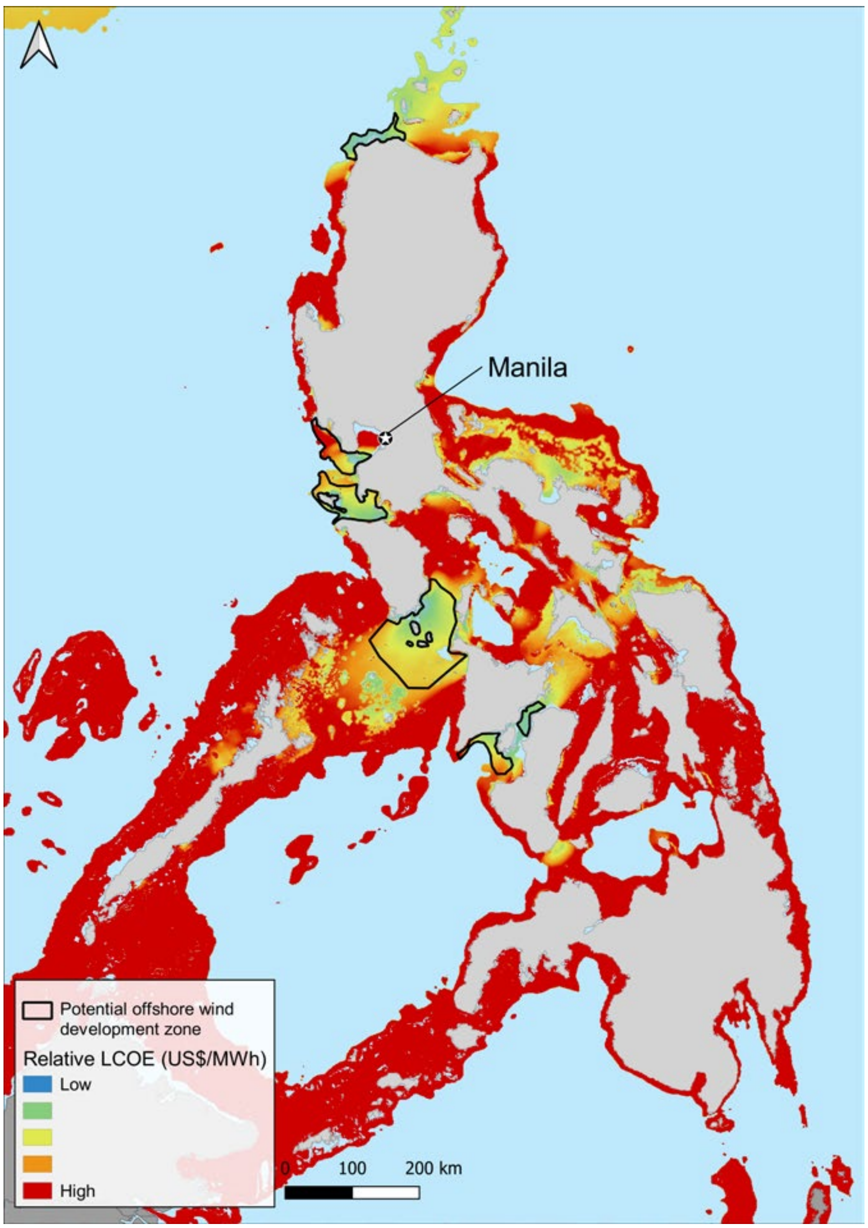
Source: see Table 9.1.

Levelized cost of energy

The LCOE from OSW is an important factor in determining the viability of projects and different sites. The wind speed is the most critical factor as this determines the energy production. Figure 9.7 and Figure 9.8 show the relative LCOE distribution in 2033 in the high growth scenario.

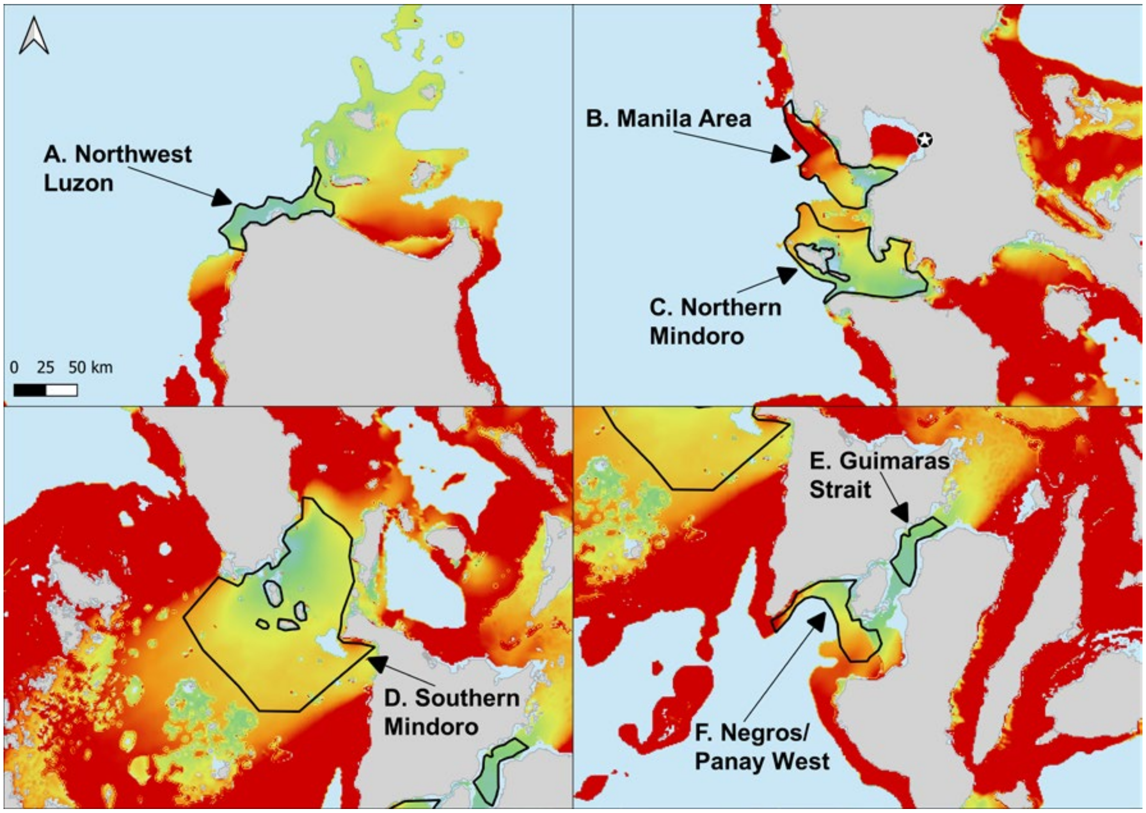
Areas with high wind speeds, shallower waters, and closer to shore and ports have lower LCOE. A key feature of the Philippines is the extensive presence of deep water, sometimes close to shore. This limits the opportunity for fixed foundations and, in some areas, for floating foundations.

FIGURE 9.7 RELATIVE LCOE FOR A REFERENCE PROJECT IN THE PHILIPPINES IN 2033 IN THE HIGH GROWTH SCENARIO



Source: see Table 9.1.

FIGURE 9.8 RELATIVE LCOE FOR A REFERENCE PROJECT IN THE PHILIPPINES IN 2033 IN THE HIGH GROWTH SCENARIO, FOCUSED ON POTENTIAL OFFSHORE WIND DEVELOPMENT ZONES



Source: see Table 9.1. For legend, see Figure 9.7.

Potential offshore wind development zones

Potential OSW development zones are shown in Figure 9.9 along with key environmental, social, and technical considerations, and listed in Table 9.3. Note that some zones have small exclusions within them, to be respected by project developers. All have varying levels of environmental, social, and technical restrictions to be addressed during project development, that in some cases will limit areas of development. None are in any disputed waters.

Figure 9.10 shows the zones, differentiating between the likely fixed and floating parts in the areas with mean wind speeds above 7 m/s.

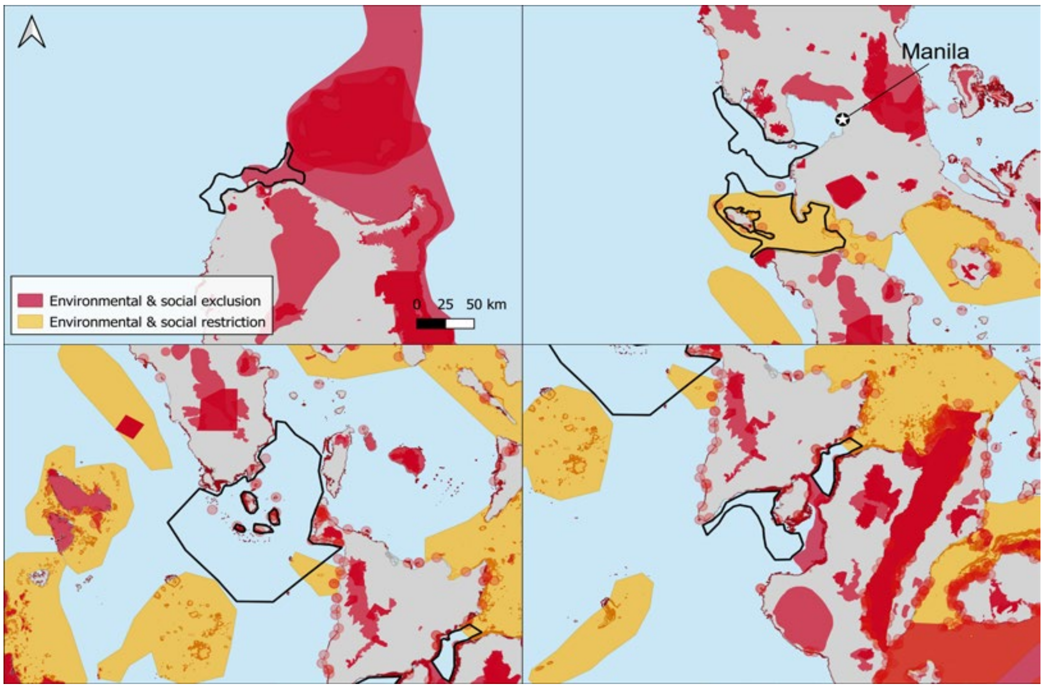
Typical power densities for OSW projects are 4 to 7 MW/km^2. Our modelling, using the spacing discussed in Section 10, uses a typical spacing of 5.4 MW/km^2. When defining larger development zones (as here), a more practical density to assume is around 40 percent of this, so 2.2 MW/km^2. This allows for siting around considerations and distance between individual projects within the zones. In Table 9.3, we provide the total area for each site and our initial subjective estimation of the practical capacity range that is likely to be accommodated, given the nature of considerations that we are aware of. We have translated this also to an equivalent whole zone density.

In summary, the combined capacity of the six zones is likely to be between 27 and 58 GW, with a density between 1.2 and 2.6 MW/km^2. A density of 2.2 MW/km^2 across all the zones gives a capacity of 46 GW.

It is highly likely that these six zones will be able to provide all the 20 GW capacity assumed in the high growth scenario up to 2040, with the potential to provide all the 40 GW capacity assumed up to 2050.

Naturally, in time, other zones could be opened up, as technology develops. Especially relevant is access to water deeper than 1,000 meters, which would open up new resource especially off northwest Luzon and Mindoro.

FIGURE 9.9 MAP OF POTENTIAL OFFSHORE WIND DEVELOPMENT ZONE LOCATIONS WITH KEY CONSIDERATIONS

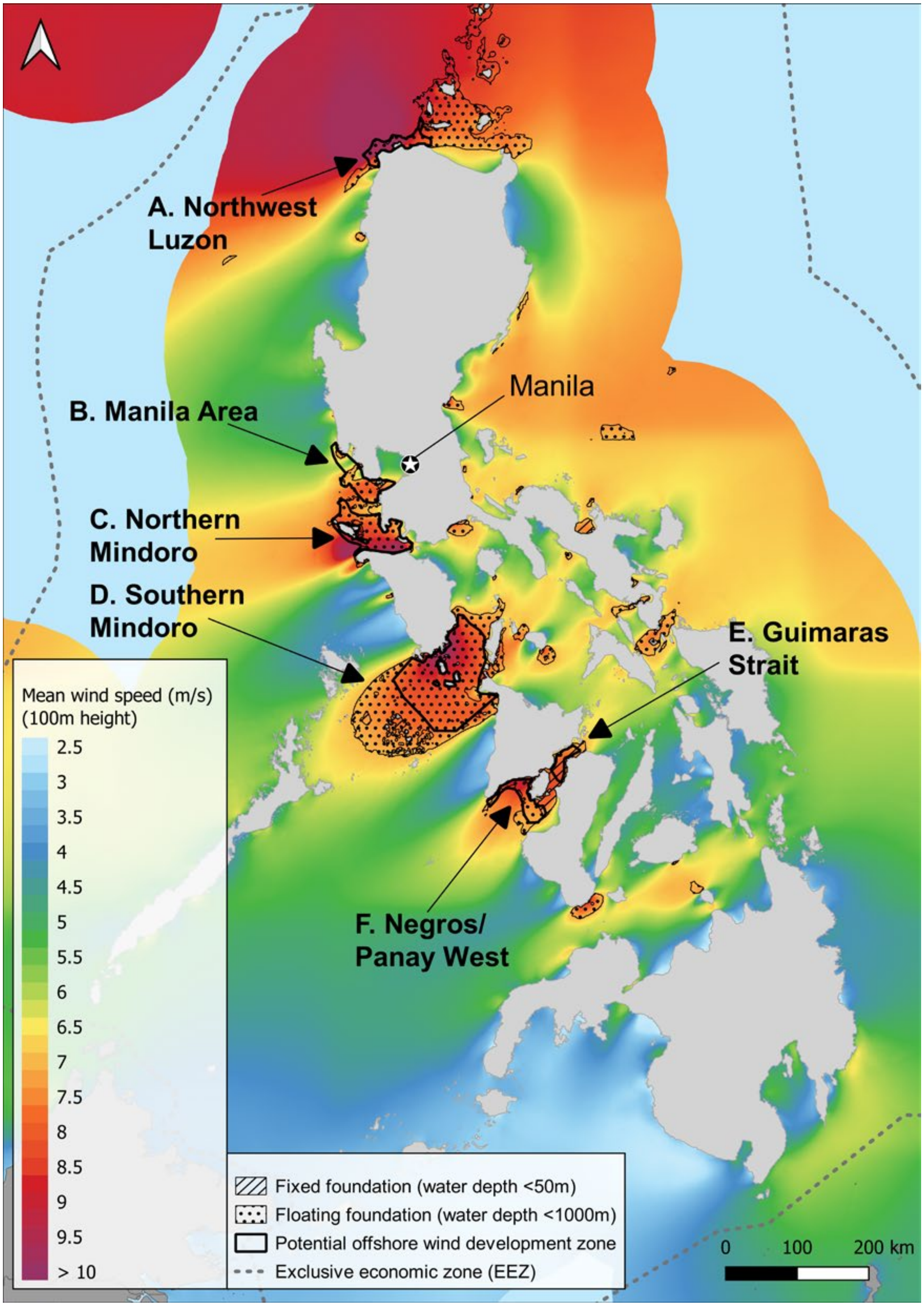


For legend and source, see Figure 9.5 and Figure 9.6.

TABLE 9.3 POTENTIAL OFFSHORE WIND DEVELOPMENT ZONES.

Area	Foundation type	Overall impact of considerations	Area (km²)	Practical capacity
A: Northwest Luzon	Floating	Marginal - shipping routes on western edge	1,571	2 to 5 GW (density 1.3 to 3.2 MW/km²)
B: Manila	Fixed and floating	Severe - shipping routes	2,281	0 to 3 GW (0 to 1.3 MW/km²)
C: Northern Mindoro	Floating	Significant - undersea cables and shipping routes	3,606	3 to 10 GW (0.8 to 2.8 MW/km²)
D: Southern Mindoro	Floating	Marginal - shipping lanes, cables, and ecological considerations	11,669	20 to 36 GW (1.7 to 3.1 MW/km²)
E: Guimaras Strait	Fixed	Significant - ecology, shipping, and proximity to shore	689	0 to 1 GW (0 to 1.5 MW/km²)
F: Negros/ Panay West	Floating	Marginal - shipping routes and cables	1,534	2 to 3 GW (1.3 to 2.0 MW/km²)
Total	**Fixed and floating**		**21,348**	**27 to 58 GW (1.3 to 2.7 MW/km²)**

FIGURE 9.10 MAP OF POTENTIAL OFFSHORE WIND DEVELOPMENT ZONES, SHOWING AREAS OF WBG TECHNICAL POTENTIAL



Source: World Bank Group and ESMAP, BVG Associates.

9.4 DISCUSSION

We have identified six zones off the west coast of the Philippines which offer potential for OSW development. In total, these zones offer a practical capacity of up to 56 GW. Two of these zones offer limited opportunity for fixed foundation turbines. The majority of the capacity, however, will be floating in depths of up to 1,000 meters.

The definition of these zones factor in a limited number of considerations. There are other sources of information which need to be included for a more accurate assessment of the potential capacity. These include the following:

- Commercial interests, such as fishing areas
- Environmental considerations, detailed information on priority biodiversity values such as threatened species
- Social considerations, such as visual impact and tourism activities
- Technical aspects, such as seabed geology and metocean conditions
- Enabling infrastructure, such as grid capacity and port facilities (initial assessments of both are included in this report).

The majority of considerations are 'soft'—they are not exclusive by default, but some allowance will typically need to be made to accommodate them. Wind farms can be built in or near shipping lanes and fishing areas, but stakeholder engagement is key to making that a successful collaboration.

Projects outside these zones are not intended to be precluded, rather that projects within are prioritized, especially after industry has had time to react to the publication of OSW development zones. In the early years, it will be important for industry confidence and in establishing an early pipeline of projects to honor existing investments in project development that may be outside these zones, but where grid connection is feasible.

Management of a transition toward strategically focused zones sensitively by the DOE will be critical to the success of OSW. Should project developers with assets outside of OSW development zones provide a strategically logical case for grid connection, then their route to market should remain open. It will be, however, important to avoid inefficient transmission network upgrades in too broad a range of areas over time.

Southern Mindoro potential offshore wind development zone

The Southern Mindoro potential OSW development zone is of key strategic relevance, as it contributes well over 50 percent of the OSW resource identified in the six potential OSW development zones. To access this potential will require strategic collaboration in a range of areas:

- Transmission network upgrades. A first network upgrade to the south of Mindoro (and onto Panay) has been considered for many years, but to date it has not made any progress. The main connection for OSW will be from the key demand center of Manila to Seminara Island or one of the other neighboring islands. Any connection should be at a scale of 5 to 10 GW or more. The lowest cost solution is likely to be subsea throughout most of its journey.

- OSW project development. Development of a similar volume of OSW projects needs to be timed to result in completed projects starting to come online as the transmission network upgrade is available. Delays in either will result in significant costs.
- Port and local workforce development. Although there are some port facilities, south of Mindoro ports do not even show up on the World Port Index as 'very small', refer Figure 14.19, and the local working population is minimal. There is, however, a logic to establishing a transshipment port in the area—it is closer to the geographical center of the Philippines and could also serve as a construction port for OSW.

9.5 RECOMMENDATIONS

Based on this analysis, the following are recommended:

- The DOE establishes OSW development zones through proportionate MSP, taking into account environmental and social considerations, stakeholder engagement, and long-term vision for transmission network development.
- The DOE also considers cumulative impact of multiple projects in a given area in MSP.
- The DOE considers how to introduce the use of such zones, respecting the existing WESCs and applications, providing guidance as to their use in focusing OSW projects in the most advantageous areas, while minimizing negative environmental, social, and economic impacts.
- The DOE initiates or coordinates wind resource measurement to build confidence in available resource and help define future OSW locations so that parallel transmission network planning can progress with confidence.

  We suggest that this be focused on the larger potential OSW development zones or areas of greatest uncertainty. It should combine new, DOE-led measurement campaigns (not located in any specific WESC areas) with use of developer data from specific project sites, coupled with a measure-correlate-predict process to predict long-term wind resource. Such a process combines on-site measurement over a small number of years with long-term datasets from nearby. Documenting and making such datasets (for example from airports) available for developers may be valuable.

  Understanding expected extreme (storm) wind speeds is also important, especially in areas with typhoon risk. Again for this, correlation with any long-term records is valuable.
- The DOE initiates or coordinates other measurement and data gathering campaigns on key technical aspects of the zones including the following:
  - Metocean campaigns, also considering typical and extreme significant wave heights and currents
  - Geological surveys of the seabed and substrates
  - Ecological surveys to address any identified gaps in current knowledge of the zones
  - Social perceptions and effect on local industries such as fishing, aquaculture, and tourism.
- Due to its strategic relevance and long lead time for development, the DOE advances a holistic feasibility study for the Southern Mindoro potential OSW development zone, considering transmission network, OSW, and port development.

10. COST OF ENERGY REDUCTION

10.1 PURPOSE

In this work package, we determine the long-term cost trajectory of OSW in the Philippines, considering global cost reduction trends, resource potential, country characteristics, regional supply chain development, and other key factors.

We do this under the two industry scenarios. This is important as it is helpful to understand, in the long term, what the cost of energy from OSW will be and how to influence this.

We focus on floating OSW, as this is likely to be the dominant technology due to the lack of availability of shallow waters in areas with good wind resource. We also model fixed projects, but do not present the detail of results.

10.2 METHOD

We modelled costs and LCOE under the two scenarios, as presented in Section 2. The context for these scenarios is discussed in Section 8.

We established baseline costs (for installation in 2028, recognizing key differences between established and Philippines projects) and trajectories (costs in 2033 and 2038) based on key parameters defined in Table 10.1.[xiii] Note details such as project lifetime gradually extending in line with the trend anticipated in established markets. We then interpolated between these points for intermediate years and extrapolated beyond them for trajectories to 2050, as described in Section 8.6.

A detailed explanation of our methodology, plus detailed definitions and assumptions, is provided in Section 10.4. The analysis presented in this section has the same basis as (and hence is fully compatible with) the spatial LCOE analysis presented in Section 10. It is also used directly as the basis for the economic benefit analysis presented in Section 12. It also uses the supply chain assumptions presented in Section 11.

The method is detailed and robust, breaking down project CAPEX and operational expenditure (OPEX) each into a number of key elements. AEP (and hence capacity factor) is derived by combining a wind speed distribution at hub height (based on mean wind speed at a height of 100 meters and a typical annual wind speed distribution and change in wind speed with height) with a representative power curve (derived for the given turbine power rating and rotor diameter). This AEP is then adjusted to account for a range of real-world factors presented in Table 10.4.

xiii 2028 was chosen as the first year of installation in both scenarios; 2033 and 2038 were chosen early in the roadmap process to provide two further, equally spaced snapshots up to 2040. These are slightly different years to those used in Section 12, which is inconsequential.

In assessing costs, we consider the regional market that is establishing in East Asia. Other markets in the region are each more advanced than the Philippines. This offers the opportunity to access what will be an experienced regional supply chain by the late 2020s, in both fixed and floating OSW. It also enables the Philippines to take the benefit of technology solutions relevant to regional challenges, such as typhoons and high seismic activity.

TABLE 10.1 KEY PARAMETERS FOR THE TYPICAL SITES MODELLED, AGAINST YEAR OF INSTALLATION

Parameter	Fixed (2028)	Floating (2028)	Floating (2033)	Floating (2038)
Water depth (meter)	25	250	250	250
Mean wind speed (at height of 100 meters) (m/s)[xiv]	8.0	9.0	9.0	9.0
Distance from construction port (kilometer)	100	200	200	200
Distance from operations port (kilometer)	20	40	40	40
Distance from grid (offshore) (kilometer)	20	40	40	40
Distance from grid (onshore) (kilometer)	20	0	0	0
Turbine rating (MW)	16	16	20	24
Rotor diameter (meter)	231	231	250	280
Project size (MW)	800	400	1,000	1,000
Project lifetime in high growth (low growth) scenario[xv] (years)	30	29	32 (31)	34 (32)

Export system assumptions

For fixed projects, which we assume are installed only in early years, we consider the cost of an export system consisting of offshore substation, 20-kilometer offshore export cable, 20-kilometer onshore export cable to the nearest onshore transmission network connection point, and new switchgear and auxiliary equipment at this point. We recognize that in some cases an offshore substation may be avoided. We have not included any further transmission network upgrade costs.

For floating projects, we assume typical projects are connected to one of the proposed high power transmission network links. In this case, we assume the cost of an export system consisting of offshore substation, 40-kilometer offshore export cable to the nearest offshore transmission network connection point, and new switchgear and auxiliary equipment at this point. We have not included any share of the cost of the high power transmission network links, as these serve multiple purposes.

We anticipate that in both cases the export system will be developed, delivered, and operated by the OSW project developer, the point of connection being the point of grid connection to the transmission network.

xiv Mean wind speeds are quoted at a standard reference height to give clarity regarding trends, and because these wind speeds characterize project sites, independent of the turbine size used. We adjust the mean wind speeds at reference height to the mean wind speeds at hub height of a given turbine when deriving AEP. This means that a higher rated turbine with larger rotor on the same site will have a higher hub high mean wind speed than a smaller turbine.

xv Over time, as global and national market experience of technology grows and the pace of LCOE decreases, project lifetimes will continue to extend. In OSW, they started at 20 years—the original default design lifetime of an onshore wind turbine. The anticipated lifetimes shown here reflect these trends.

Experience in Europe is that some early onshore wind projects were repowered with larger turbines before the end of their design life due to the rapid pace of technology development offering a better return from the site through repowering than continuing operation. Generally now, most owners seek to extend the operating life of their projects beyond the initial design life. By the time first projects are installed in the Philippines, the same situation is likely, with a drive to extend the life of operating projects where possible.

10.3 RESULTS

LCOE results in this roadmap were derived as mid- (P50) estimates, meaning 50 percent chance of exceedance. We are currently experiencing much volatility in commodity prices, meaning that there is significant uncertainty about where such prices will head over the next five years. OSW uses large volumes of raw material (dominated by mild steel, typically followed by cast iron, aluminum, composites, and copper).

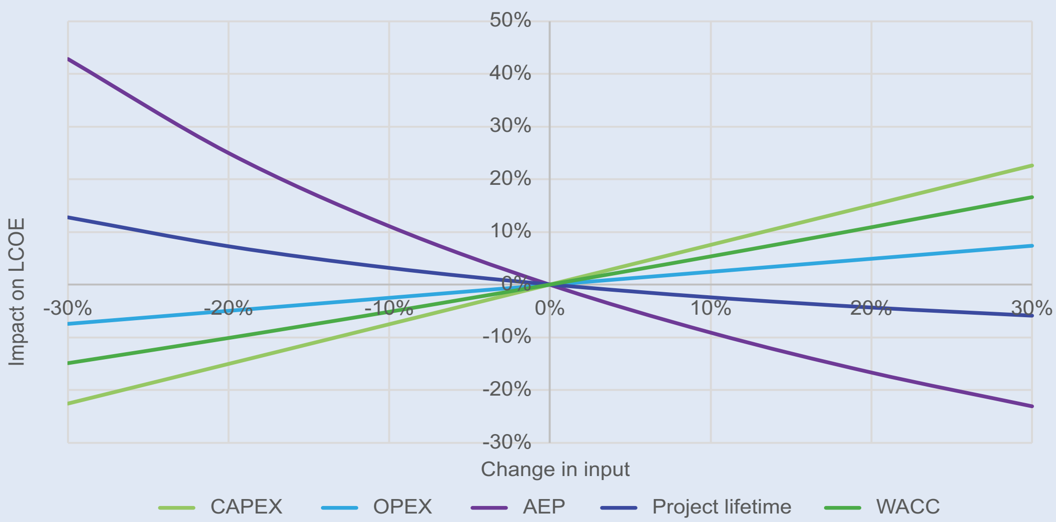
Changes in energy prices also affect OSW, both through the energy needed to manufacture components and to fuel installation and operation vessels. Changes in energy prices have an even greater impact on electricity price from fuel burning.

In this context, throughout the roadmap we have continued to state mid-estimates, but we recognize uncertainties, for example, due to the following:

- Technology. How will past trends of significant reduction in cost change looking forward?
- Supply chain (including commodity prices). How will competition in the global and local supply chain evolve, and what will be the long-term trends in commodity prices?
- Finance. How will competition to finance OSW develop?

To give an understanding of the sensitivity of OSW LCOE to key parameters, see Figure 10.1.

FIGURE 10.1 SENSITIVITY ANALYSIS AROUND PHILIPPINES FIXED PROJECT INSTALLED IN 2028.



The LCOE for the fixed and floating Philippines sites under the two scenarios is shown in Table 10.2 and Figure 10.2, along with established market trends,[xvi] indicative uncertainty bars, and an indicative comparator (traditional technology, assumed to be coal-based), as discussed in Section 7.1.[xvii] The LCOE trends are compatible with the LCOE reduction trajectories seen in established markets. For a detailed discussion and background reading on LCOE reduction, see Section 2.2 of World Bank Group's *Key Factors* report.[4]

- The main differences between the floating Philippines sites modelled and established market floating projects are that the Philippines sites have lower wind speeds, deeper water and are further from construction port. Lower wind speeds and longer distances to construction port also apply for fixed projects, although they are likely to be in shallower water than typical in established markets.
- The other main differences between the Philippines and established markets projects relate to the location of supply and the risks associated with projects. As discussed in Sections 11 and 12, there is limited supply from the Philippines, with most supply coming from a number of established East Asian markets. Less experienced supply chains can add cost and risk in the early years.
- The LCOE of floating OSW remains above that of fixed OSW in the established market case, but by 2038 the gap is only 10 percent. In the Philippines, even before this, many floating sites with good wind resource will offer lower LCOE than the limited fixed sites that are available with lower wind resource. As there is inadequate market opportunity for fixed OSW projects in the Philippines due to limited shallow water with high mean wind speeds, and LCOE for fixed projects starts off lower, it is anticipated that a small volume of fixed projects will happen first, but then the market will switch to floating projects. For this reason, no LCOE is shown for fixed projects in the Philippines in 2038. The main differences between the Philippines and established market projects are the lower wind speeds and higher costs in the early years.
- The LCOE of floating OSW remains above that of fixed OSW, but it expands the capacity available. By 2035, LCOE of floating OSW is only 15 percent higher than that of the best fixed OSW sites (and comparable to the available OSW sites).
- LCOE in the low growth scenario is 12 percent higher than in the high growth scenario in 2033. This gap grows to 23 percent by 2038.

The detail behind these headline LCOE trajectories is discussed in the following subsections. Note that data relate to scenarios, with smooth trends shown over time. In reality for new projects the project sizes, costs, lifetimes, cost of money, and nominal capacity factors will vary from this trend. In addition, actual generation for operating projects will vary with year-by-year mean wind speeds.

Note also that the trends presented here are of technology costs on typical sites with properties consistent over time. In reality, sites will be developed in an order driven by LCOE, transmission network availability, and other practical considerations. As discussed in Section 2.1, this is likely to mean the real-world competitiveness of floating projects will take place earlier than shown by this technology-focused comparison.

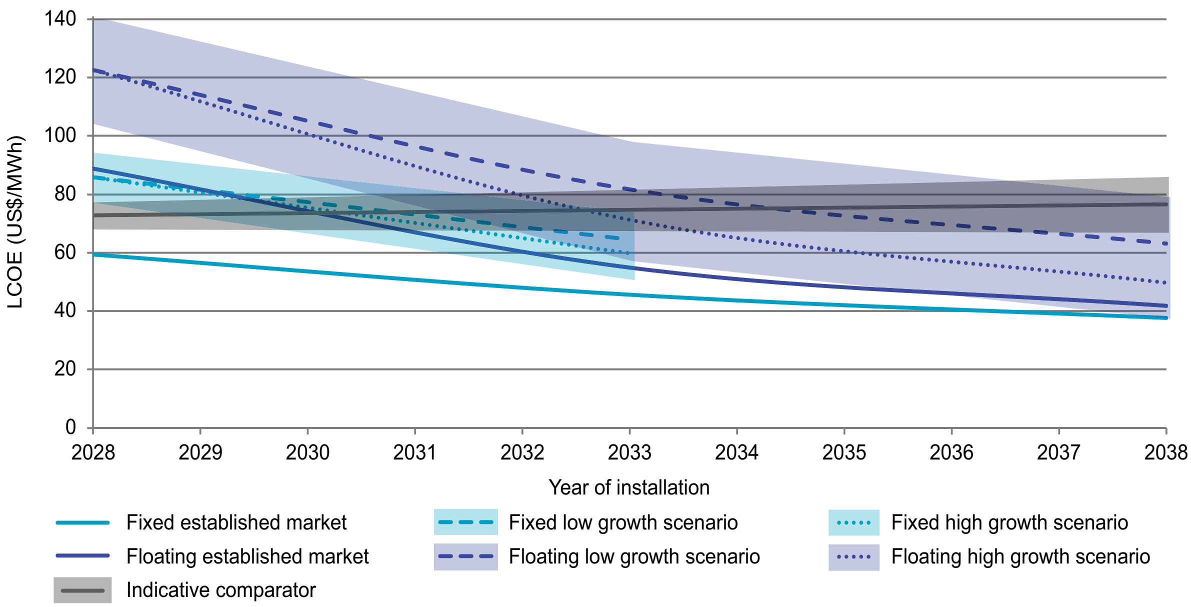
xvi The established market trends are based on the same bottom-up modelling discussed in Section 10.4, but using typical turbine sizes and site conditions anticipated in established markets over the period.

xvii Uncertainty bars for established market trends are not shown, for simplicity, but will be slightly narrower (in percentage terms) than for the Philippines.

TABLE 10.2 INDICATIVE LCOES FOR THE TYPICAL PHILIPPINES SITES MODELLED

Year of installation	Philippines fixed low growth scenario (US$/MWh)	Philippines fixed high growth scenario (US$/MWh)	Philippines floating low growth scenario (US$/MWh)	Philippines floating high growth scenario (US$/MWh)	Established market fixed (US$/MWh)	Established market floating US$/MWh)
2028	86 (likely range ±10%, 77 to 95)[xviii]		123 (likely range ±15%, 104 to 141)		59	89
2033	65	60	82	71	46	55
	(likely range ±15%, 51 to 74)		(likely range ±20%, 57 to 98)			
2038	Not applicable, as limited resource available		63	50	38	42
			(likely range +/-25%, 37 to 79)			

FIGURE 10.2 ESTIMATED LCOE TRAJECTORY FOR THE PHILIPPINES, COMPARED TO ESTABLISHED MARKET TRENDS AND INDICATIVE COMPARATOR.



Source: BVG Associates.

xviii LCOEs at each end of this likely range could be obtained in various ways, for example:

- Lower end of range US$77 per MWh achievable through any of the following:
- Commodity prices return from current higher prices to 2020 levels.
- WACC is reduced from 6.0 percent to 5.5 percent through project de-risking, more balance sheet financing, and access to increased levels of concessional finance and CAPEX and OPEX reduced by 6 percent through commodity prices returning toward 2020 levels.
- Measurements show wind resource 8 percent better than anticipated and project life extended by three years (reflecting anticipated trend in established markets).

Upper end of range US$95 per MWh through any of the following:

- Further 10 percent increase in CAPEX and OPEX due to further commodity price rises.
- WACC increases from 5.5 percent to 7.1 percent due to perceived market risks.
- Measurements show wind resource 9 percent worse than anticipated.

Note that the likely ranges are indicative, designed to represent PHP 20 to PHP 80. It is still possible that the LCOE reaches higher or lower values than those represented in this range.

Note that Figure 10.2 shows that from early on, OSW competes well with the comparator. This is because following the high growth scenario, the roadmap drives the following:

- Development of a large-scale, long-term market based on strong logic and clear vision and supported by robust, transparent frameworks to de-risk project development, evolved from current arrangements, rather than starting afresh.
- Delivery of large-scale projects (800 MW) from the start, as the global industry will be mature enough by then to not need the ramp-up seen over years in established markets that were also managing significant growth in turbine size.
- Focus on cost reduction, through clear policy intent, with visibility of competition from a long way out and without restrictive local content requirements. This means that the Philippines will be able to benefit from what will be a highly experienced regional and global supply chain by the time first projects are installed in 2028, with local supply growing consistently over time.
- Availability of low-cost finance, through competitive local and international commercial debt and by accessing concessional finance through involvement of multilateral development banks (MDBs).
- Government-industry collaboration in a task force involving local and international project developers and key suppliers, to work together to address roadmap recommendations and other considerations, as they arise.
- Industry commitment to making OSW competitive in these time scales is critical to securing the support needed to drive roadmap actions at the pace described in Section 5.

If, toward 2028, the competitive position is somewhat delayed, then some projects may be deferred until they can meet any auction price cap. The overall trend of reducing OSW LCOE and increasing comparator cost will mean that delays are unlikely to be significant.

Likewise, the roadmap is designed so that the most competitive early floating projects start to be installed around 2030, but allowing the market to define the actual timing of the transition between fixed and floating projects (with the indicative high grow scenario in Figure 2.4), depending on the following:

- The competitiveness of remaining fixed projects, based on the limited resource available
- The relative cost of floating and fixed OSW at the time
- The pace of transmission network and other roadmap action to enable delivery of projects in the most attractive areas.

Table 10.3 shows the breakdown of CAPEX and OPEX plus energy production, project lifetime, and WACC from which the LCOEs for fixed and floating OSW in established and Philippines market in 2028 have been calculated. Note that unrounded central values output from modelling is shown for full transparency. The uncertainty discussed above is not shown.

TABLE 10.3 COST ELEMENT BREAKDOWN SUPPORTING LCOES FOR 2028

Cost element	Unit	Established market fixed	Established market floating	Philippines fixed	Philippines floating
Project development	US$/MW	131,625	217,271	158,506	254,394
Turbine	US$/MW	1,308,917	1,462,322	1,384,011	1,541,123
Foundation	US$/MW	335,445	1,102,148	324,816	1,180,078
Array cables	US$/MW	38,107	43,020	36,348	40,966
Installation of generating assets	US$/MW	226,875	200,601	272,785	376,641
Offshore substation	US$/MW	109,340	226,340	110,844	236,525
Export cables	US$/MW	140,069	108,259	63,991	64,762
Installation of transmission assets	US$/MW	99,192	152,540	176,559	242,252
Total CAPEX	US$/MW	2,389,571	3,512,500	2,527,861	3,936,742
Operation and planned maintenance	US$/MW/yr	43,462	48,281	37,627	42,324
Unplanned service	US$/MW/yr	27,637	36,016	25,803	34,332
Total OPEX	US$/MW/yr	71,099	84,297	63,430	76,657
Net AEP	MWh/MW/yr	4,180	4,340	3,205	3,825
Project lifetime	year	31.7	31.7	30.1	28.5
WACC*	%	5.1	6.3	6.0	7.5
LCOE**	US$/MWh	59.1	88.7	85.9	122.5

Note: *The WACC for these initial projects in the Philippines is assumed to be lowered by concessional finance blended with commercial debt. As an example, the 6.0 percent is made up of 50 percent concessional debt at about 3.5 percent; 30 percent commercial, non-recourse project debt at 7 percent; and 20 percent equity at 11 percent. Currently, projects in emerging markets are at higher risk than in Europe, where large project developers often balance sheet finance, say with 35 percent debt (against their own balance sheet rather than the project) at about 1 percent and 65 percent equity at about 7 percent, giving WACC below 5 percent. Should this practice extend to emerging markets faster than expected, this will offer lower WACC and hence lower LCOE. Likewise, should this not happen and concessional finance is not available, this will drive higher WACC and LCOE, according to Figure 10.1.
** See Table 10.4 for treatment of construction phase contingency and decommissioning.

Floating offshore wind

The global LCOE reduction for floating OSW in Figure 10.2 comes from improving technology and processes, increasing turbine size, and increasing farm size.

The increases in turbine and farm size bring economies of scale in manufacture and logistics, including OMS. There are also economies of scale in individual components because the larger turbines need less infrastructure per MW.

Technology improvements include those in design and manufacture of floating foundations and mooring systems and optimizing both energy production and maintenance and service of floating OSW projects.

LCOE in 2028

In the Philippines, the floating LCOE in 2028 is just over 30 percent higher than in established markets. Half of this is due to the different site conditions—lower wind speeds (resulting in lower AEP), requirements for typhoon resistance, deeper water, and further from construction port. Other key contributions are increased WACC and inefficiencies from installation and other activities in a new market. We derived this factor by considering each cost item in Table 10.4, assigning a multiplier relating to typical change in efficiency when working in a new market, a multiplier for change in cost base, and a multiplier for any other relevant consideration. These factors are beyond the impact of change in basic site characteristics between the established market and the Philippines.

For example, for project development of the typical fixed project in 2028, the following was applied:

- An estimated 160 percent factor was applied to account for efficiency in a new market (many items will be more expensive as much of the learning from established markets will be lost, for first projects).
- An estimated 75 percent factor was applied to account for lower cost base (mainly labor cost).
- The project development cost for Philippines site conditions is 98 percent of that for established market conditions, assuming the same established market supply chain for both, as derived from the BVG Associates cost model.
- Overall, a 117 percent factor was applied to the established market cost in 2028 for project development. In other words, project development in the Philippines is assumed to cost about 20 percent more than for the typical project defined for this year in an established market.

As a further example, for installation of generating assets, the following was applied:

- An estimated 140 percent factor was applied to account for efficiency in a new market.
- An estimated 90 percent factor was applied to account for cost base.
- The cost for installation of generating assets based on Philippines site conditions is 149 percent of that for established market conditions, assuming the same established market supply chain for both, as derived from the BVG Associates cost model.
- Overall, a 188 percent factor was applied to the established market cost in 2028 for installation of generating assets.

LCOE trajectory in the low growth scenario

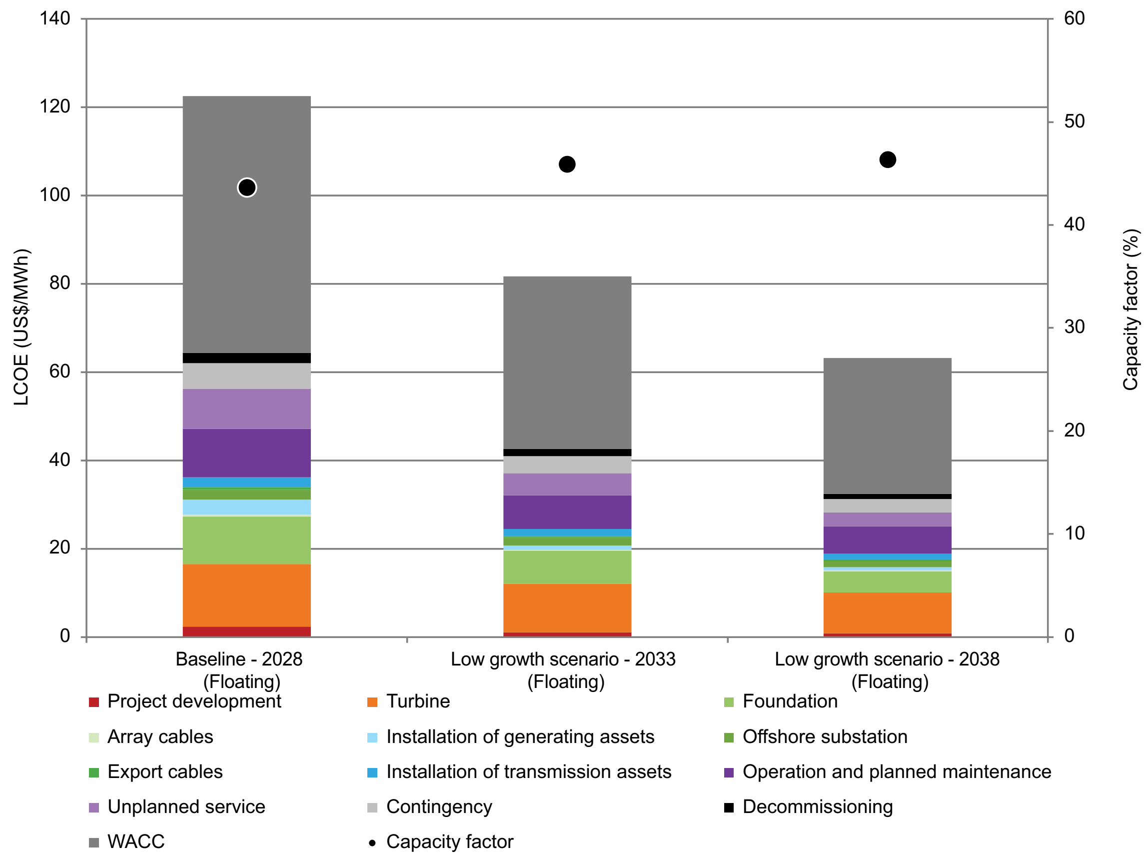
Over the period, the LCOE premium in the Philippines from setting up in a new market reduces. A solid regulatory environment with visibility enables some investment in capacity and learning, but constructing only one project every four years limits this. Over time, the WACC drops somewhat due to increased certainty in all aspects of project life cycle and revenue. We have assumed the following over time:

- Ongoing local supply of substation topside structures and assembly of offshore substations, construction of onshore substations and grid connections but little other supply of local components
- Gradually increased localization of project development services
- Gradually increased use of local installation and operation services, including some component refurbishment.

As shown in Table 10.1, we have assumed constant site characteristics but the use of state-of-the-art larger turbines in line with the global market.

The LCOE breakdown and capacity factors for floating OSW in the low growth scenario are shown in Figure 10.3.

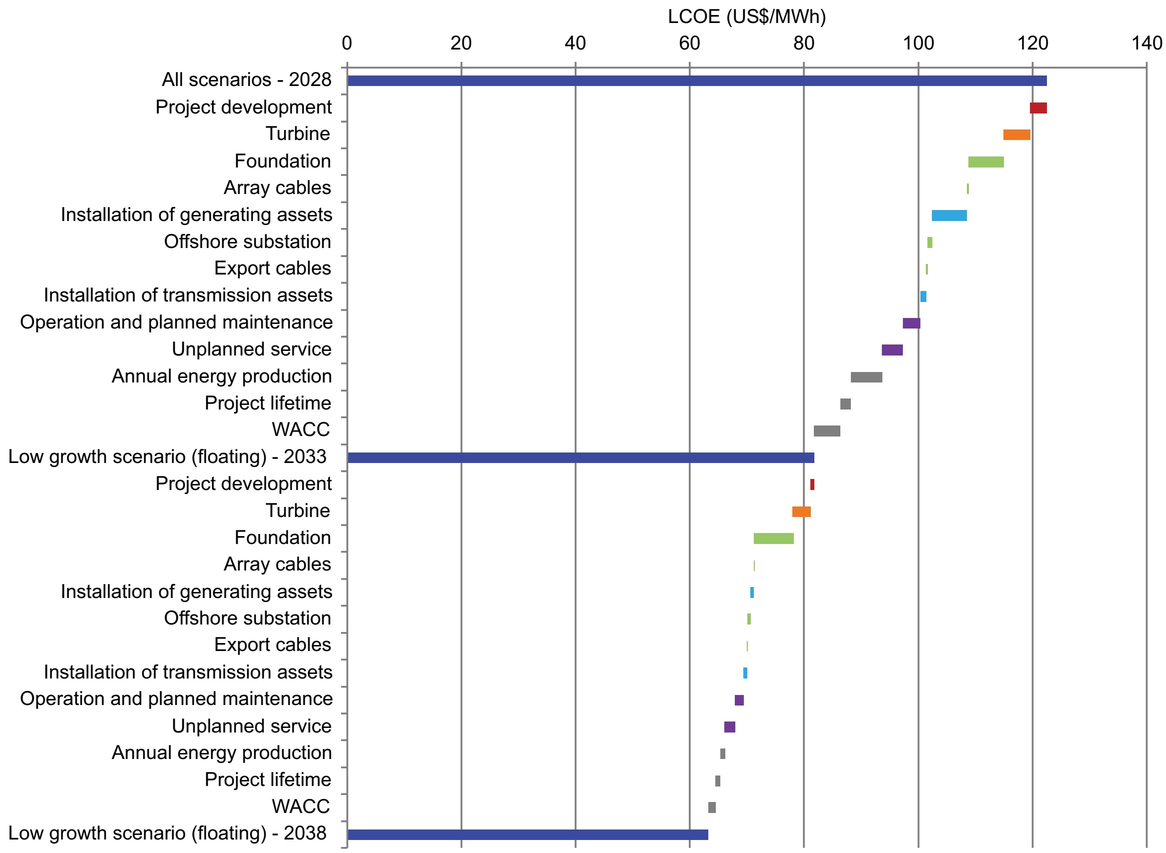
FIGURE 10.3 LCOE BREAKDOWN FOR FLOATING OFFSHORE SITES IN THE LOW GROWTH SCENARIO



Source: BVG Associates.

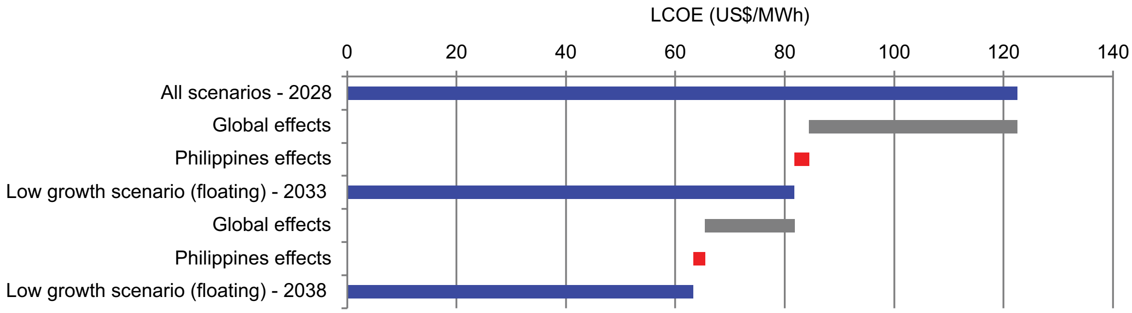
Much of the LCOE reduction between 2028 and 2033 comes from the use of larger turbines, improvements in the design and manufacture of floating foundation hulls and mooring systems, and improvements in OMS strategies, as shown in Figure 10.4. This is mainly due to progress in the global market (relating also to the scale of the global market), rather than in the Philippines, as shown in Figure 10.5. In the period from 2033 to 2038, LCOE reduction is due mainly to further progress with floating foundations and OMS.

FIGURE 10.4 SOURCE OF LCOE REDUCTION BY COST ELEMENT FOR FLOATING OFFSHORE SITES IN THE LOW GROWTH SCENARIO



Source: BVG Associates.

FIGURE 10.5 SOURCE OF LCOE REDUCTION BY GEOGRAPHY FOR FLOATING OFFSHORE SITES IN THE LOW GROWTH SCENARIO



Source: BVG Associates.

LCOE trajectory in the high growth scenario

Over the period, the LCOE premium in the Philippines from setting up in a new market reduces more significantly than in the low growth scenario and the premium is more than offset by benefits in terms of labor cost. A solid regulatory environment with visibility of a strong, constant pipeline of projects enables investment in capacity and learning. Towers and most floating foundations are manufactured locally and more OSW services are provided locally, with increasing efficiency. Competition drives innovation and cost reduction. Logistics costs are reduced and, critically, the WACC drops due to increased certainty in all aspects of project life cycle and revenue.

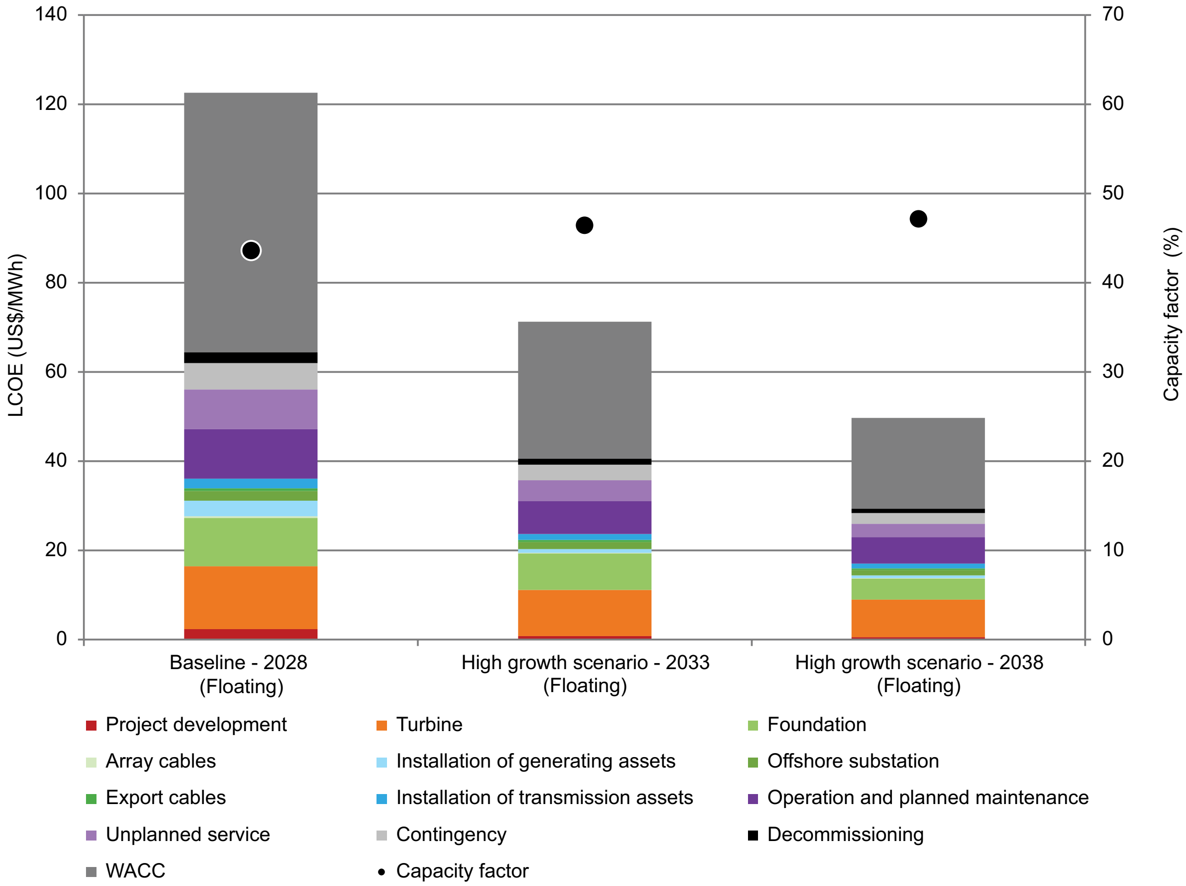
Compared to the low growth scenario, we have assumed the following:

- Similar localization of project development services and offshore substation activities
- Localization of manufacture of turbine towers and most floating foundations
- Increased involvement of local suppliers during installation
- More local supply of replacement components during operation.

The site conditions are the same as for the low growth scenario.

The LCOE breakdown and capacity factors for floating OSW in the high growth scenario are shown in Figure 10.6.

FIGURE 10.6 LCOE BREAKDOWN FOR FLOATING OFFSHORE SITES IN THE HIGH GROWTH SCENARIO

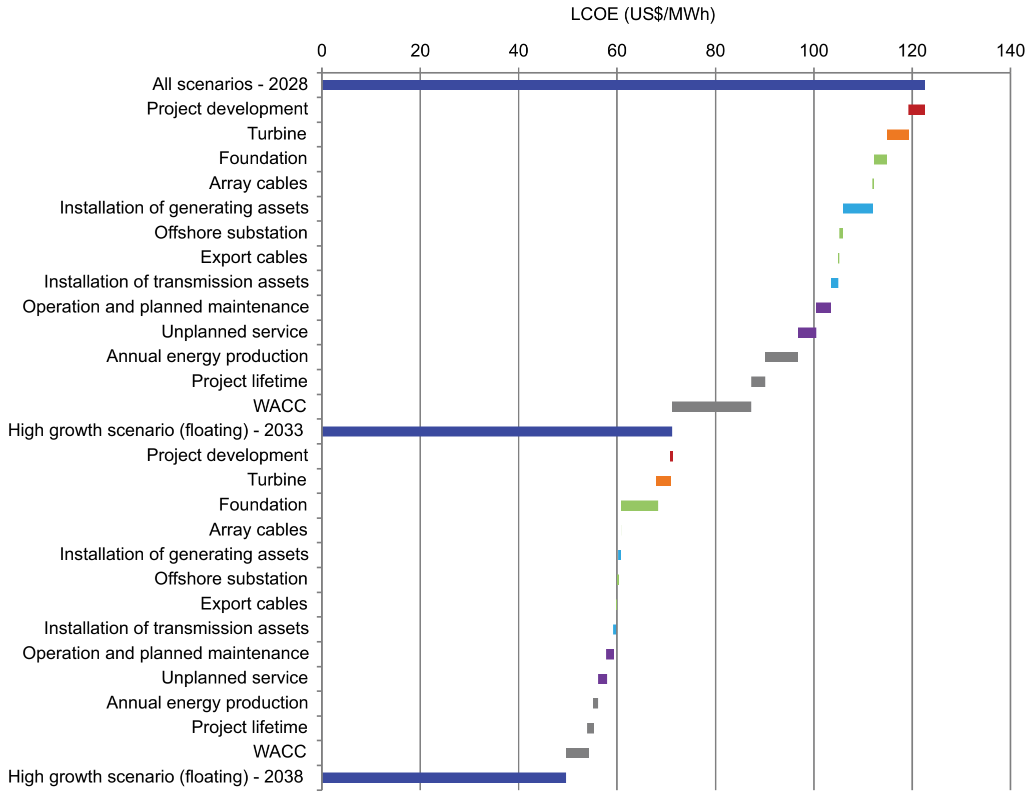


Source: BVG Associates.

As for the low growth scenario, the source of the LCOE reduction is shown by cost element in Figure 10.7. The largest difference compared to the low growth scenario is increased reduction in WACC due to further decreased market risk and increased competitive tension between lenders. In other areas, the savings are due to increased learning, turbine rating, competition, and international collaboration.

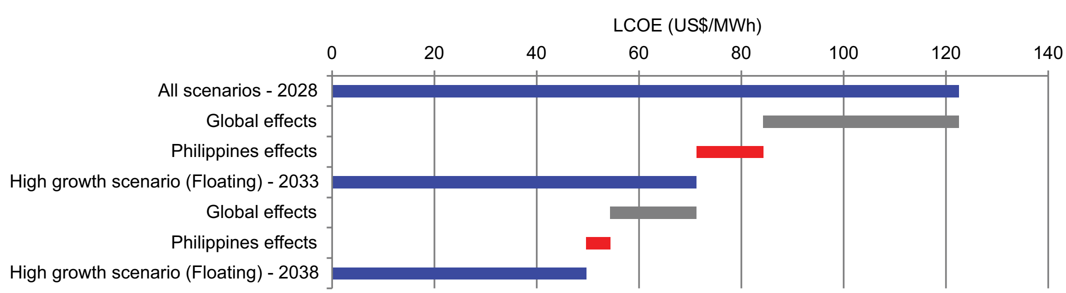
The source of the same LCOE reduction is depicted by geography in Figure 10.8, showing that global activity is dominant in driving cost reduction in the Philippines. In comparison to the reduction in the low growth scenario, the Philippines effects are greater, reflecting the increased local progress in efficiencies and risk reduction. This is in part dependent on successful localization of supply of towers and floating foundations. It must be noted that this, together with the dependence on international cost reductions, introduces some level of uncertainty over the LCOE reductions estimated over the next decades.

FIGURE 10.7 SOURCE OF LCOE REDUCTION BY COST ELEMENT FOR FLOATING OFFSHORE SITES IN THE HIGH GROWTH SCENARIO



Source: BVG Associates.

FIGURE 10.8 SOURCE OF LCOE REDUCTION BY GEOGRAPHY FOR FLOATING OFFSHORE SITES IN THE HIGH GROWTH SCENARIO



Source: BVG Associates.

Fixed offshore wind

We derived the baseline in 2028 for fixed OSW in the same way as above. Without local heavy lift and jack-up installation vessels, we assumed less local supply than for floating projects, but made other comparable assumptions about areas of supply such as project development. We applied a somewhat lower premium on WACC and derived a LCOE reduction trajectory relatively similar to floating. We assumed that the differences between floating and fixed OSW observed in other markets will be similar in the Philippines. There is a similar increase in cost and risk and a similar ability to build in sites with higher wind speeds. As such, we assumed that the LCOE differences between these technologies in the global market will be reflected in the Philippines, reducing to small differences during the early 2030s.

10.4 BACKGROUND: DETAILS OF METHODOLOGY

Definition of levelized cost of energy

At its most simple, LCOE is the cost of the project divided by the energy produced. The technical definition is

$$LCOE = \frac{\sum_{t=s}^{n} \frac{I_t + M_t}{(1+r)^t}}{\sum_{t=s}^{n} \frac{E_t}{(1+r)^t}}$$

Where:

It	Investment expenditure in year *t*
Mt	OMS expenditure in year *t*
Et	Energy generation in years *t*
r	Discount rate
s	Start year of the project
n	Lifetime of the project in years.

We use a WACC method to establish the discount rate. That is, a rate based on the weighted average of the debt and equity portions of the financing, from inception of the project to decommissioning.

Method for cost analysis

The analysis presented in Section 10 is based on a significant body of work peer reviewed through many published reports and private projects with industry clients in Europe, the US, and Asia.

In effect, here we have conducted a *study of studies*, where we access published, and unpublished, studies that we have been involved with (or have received in delivery of consultancy projects). This gives a far better dataset than is in the public domain.

This is appropriate at this stage because there are no projects operating (or even designed) at this scale in the Philippines.

Key to the analysis are the following steps:

A. Create established market baseline for projects installed in 2028, 2033, and 2038, considering larger turbines and larger projects but deeper water and further from shore over time. We did this using cost models proven over time. A schematic of the inputs and outputs of a typical single BVG Associates cost model run is shown in Figure 10.9. This step involved three cost model runs.

B. Create Philippines starting point in the same way but using Philippines sites conditions for a typical floating and a typical fixed project in each time period. At this stage results are still for established market conditions (and supply chain). This step involved six cost model runs. Note that this same process, with a simplified step C, is used for each individual cell in the preparation of the LCOE map derived in Section 9.

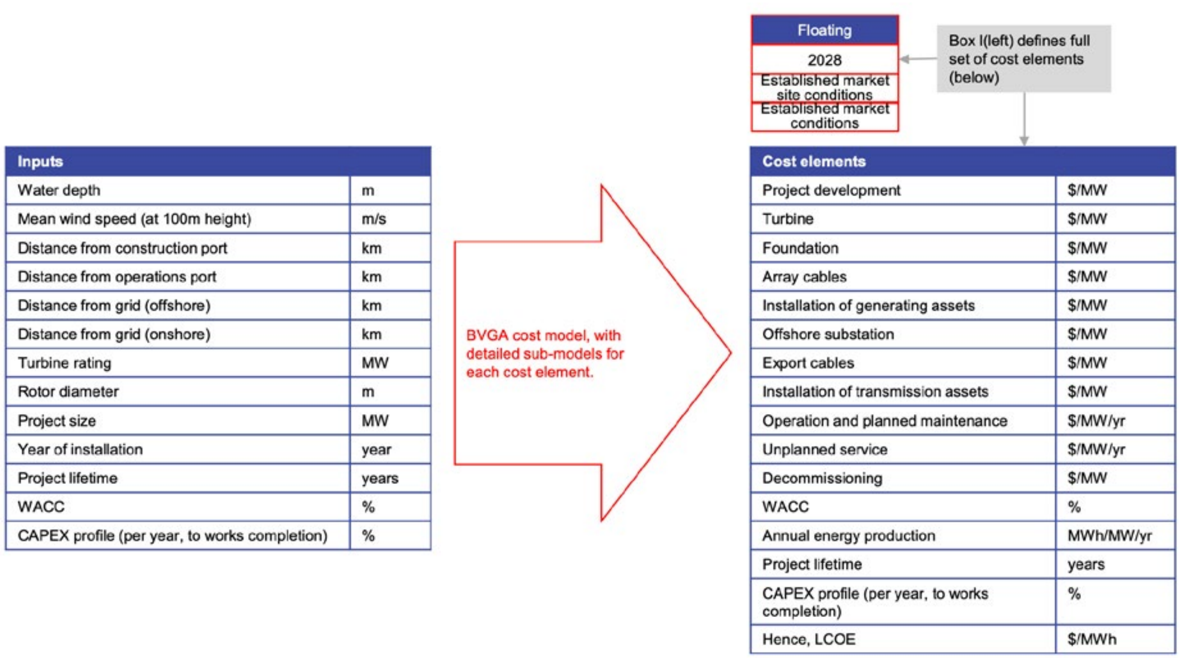
C. Convert each cost element to the Philippines market (and supply chain) conditions for both OSW scenarios. For each cost element shown in Table 10.4, we established scaling factors to take account of differences in market efficiency, cost base compared to an established market, and other considerations. We considered the following:

- Transitory effects, such as lack of industry inexperience and high regulatory risk. For example, if we applied a cost premium in step 2, we assumed that by 2038 in the high growth scenario, much of that premium had been removed by more rapid learning than in Europe during the same period.
- Permanent effects, such as need to design for typhoon survival. In some of these cases, we assumed a larger early transitory cost penalty which reduced in time, for example, as design for typhoon resistance gets more optimized.
- Changes in supply, as more Philippines wider regional content is used.

To do this, we used our experience of other new markets and feedback about the Philippines. A schematic of the inputs and outputs of a single conversion process is shown in Figure 10.10. This step involved 12 conversions, each with a set of scaling factors.

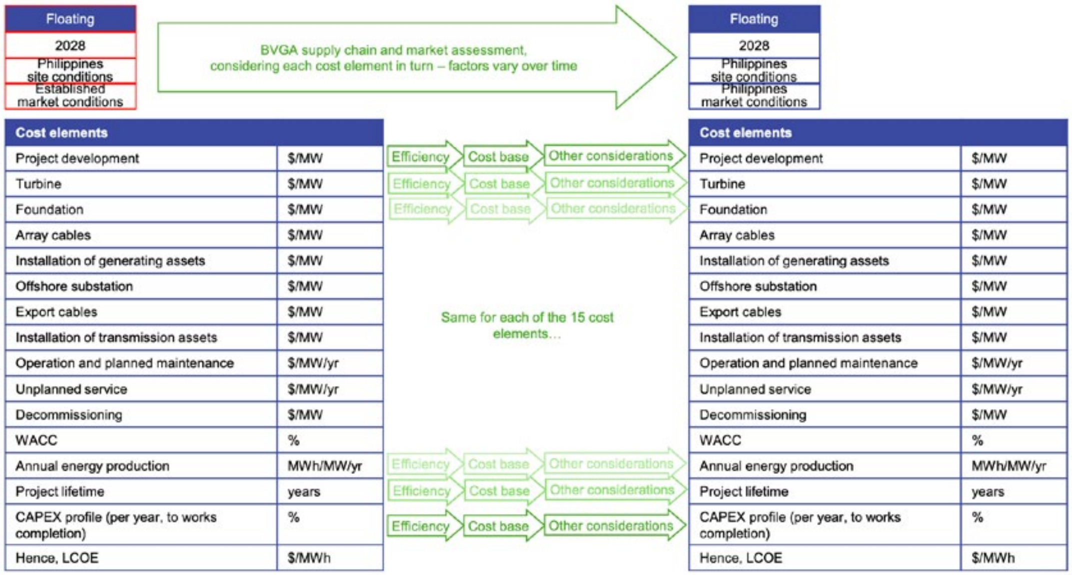
D. Combined the results of the above to derive the LCOE trends shown in Figure 10.2. A schematic showing the source of each trend is shown in Figure 10.11.

FIGURE 10.9 SCHEMATIC SHOWING INPUTS AND OUTPUTS FOR THE BVGA COST MODEL RUN



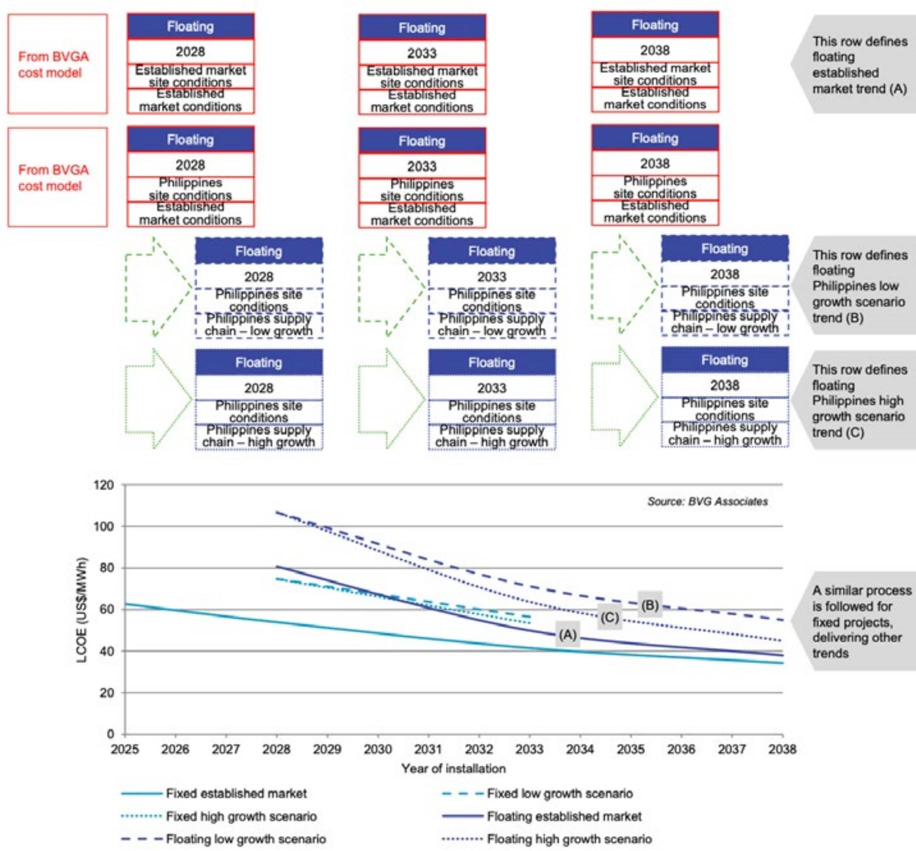
Source: BVG Associates.

FIGURE 10.10 SCHEMATIC SHOWING CONVERSION FROM ESTABLISHED TO LOCAL MARKET CONDITIONS



Source: BVG Associates.

FIGURE 10.11 SCHEMATIC SHOWING DERIVATION OF LCOE TRENDS



Source: BVG Associates.

Cost element definitions

TABLE 10.4 PROVIDES DEFINITIONS FOR FLOATING OSW

Type	Element	Definition	Unit
Development expenditure (DEVEX)	Project development	Development, permitting, and project management work paid for by the developer up to works completion date (WCD). Includes • Internal and external activities such as environmental and wildlife surveys; met ocean surveys; met mast (including installation); geophysical, geotechnical, and hydrological services; and engineering (pre FEED) and planning studies • Permitting services • Further site investigations and surveys after FID • FEED studies • Environmental monitoring during construction • Development costs of transmission system • Project management (work undertaken or contracted by the developer up to WCD) • Other administrative and professional services such as accountancy and legal advice • Any reservation payments to suppliers. Excludes • Construction phase insurance • Suppliers own project management.	US$/MW
CAPEX	Turbine	Includes • Payment to wind turbine manufacturer for the supply of: • Rotor, including blades, hub, and pitch system • Nacelle, including bearing, gearbox, generator, yaw system, the electrical system to the array cables, control systems, and so on • Tower • Assembly thereof • Delivery to nearest port to supplier • Warranty • The wind turbine supplier aspects of commissioning costs. Excludes • Turbine OPEX • Research, design, and development (RD&D) costs.	US$/MW

Type	Element	Definition	Unit
	Foundation	Includes • Payment to suppliers for the supply of the support structure comprising the foundation (including floating, mooring and any piles or anchors, transition piece, and secondary steel work such as J-tubes and personnel access ladders and platforms) • Delivery to nearest port to supplier • Warranty. Excludes • Turbine tower • Foundation OPEX • RD&D costs.	US$/MW
	Array cables	Includes • Payment to manufacturer for the supply of array cables • Delivery to nearest port to supplier • Warranty. Excludes • OMS costs • RD&D costs.	US$/MW
	Installation of generating assets	Includes • Transportation of all from each supplier's nearest port • Preassembly work completed at a construction port • All installation work for array cables, moorings, floating hulls, and turbines • Commissioning work for all but turbine (including snagging post WCD) • Subsea cable protection mats and so on, as required • Offshore logistics such as weather forecasting, additional CTVs, and marine coordination • Shared wind farm infrastructure such as marker buoys. Excludes • Installation of offshore substation/transmission assets.	US$/MW
	Offshore substation	Includes • Payment to manufacturer for the supply of offshore substations • Assembly at fabricator's port • Warranty. Excludes • OMS costs • RD&D costs.	US$/MW
	Export cables	Includes • Payment to manufacturer for the supply of onshore and offshore export cables • Delivery to nearest port to supplier • Warranty. Excludes • OMS costs • RD&D costs.	US$/MW

Type	Element	Definition	Unit
	Installation of transmission assets	Includes • Transportation of all from each supplier's nearest port • Preassembly work completed at a construction port before the components are taken offshore • Installation of offshore substations and onshore and offshore export cables • Supply and installation of the wind farm-specific switchgear and auxiliary equipment in the substation that is located on the transmission network, including any wind farm-specific buildings at the onshore substation • Substation commissioning work (including snagging post WCD) • Scour protection (for support structure and cables) • Subsea cable protection mats and so on, as required • Offshore logistics such as weather forecasting, additional CTVs, and marine coordination.	US$/MW
	Contingency	Construction contingency and other CAPEX contingency. Also construction phase insurance cover, from start of construction until operation, including all construction risks and third party.	Assumed increases LCOE by 5%
OPEX	Operation and planned maintenance	Includes operation and planned (routine) maintenance, operations phase insurance, and other OPEX and transmission OPEX. Starts once first turbine is commissioned. Operation and planned maintenance includes the following: • Operational costs relating to the day-to-day control of the wind farm (including CAPEX on operations base as an equivalent rent) • Condition monitoring • Planned preventative maintenance, health, and safety inspections. Operations phase insurance: • Takes the form of a new operational 'all risks' policy and issues such as substation outages, design faults and collision risk become more significant as damages could result in wind farm outage. Insurance during operation is typically renegotiated on an annual basis. Other OPEX covers fixed cost elements that are unaffected by technology innovations, including the following: • Site rent • Contributions to community funds • Monitoring of the local environmental impact of the wind farm. • Transmission OPEX includes all OMS for the transmission assets.	

Type	Element	Definition	Unit
	Unplanned service	Unplanned service includes the following: • Reactive service in response to unplanned systems failure in the turbine or electrical systems • Unplanned service may be either proactive or reactive.	US$/MW/yr
Decommissioning (DECEX)	Decommissioning	Includes • Decommissioning, which comprises planning work and design of any additional equipment required to meet legal obligations. Includes further environmental work and monitoring • Removal of the turbine, foundation, mooring, and offshore substation • Removal or cutoff of piles/anchors, array cable, and export cable (where applicable) • Removal of the onshore transmission asset (where applicable).	Assumed increases LCOE by 2%
Financing cost	WACC	The discount rate is made up of finance cost from debt and equity, weighted by their contributions to give a WACC. It is in real, pre-tax terms.	—
AEP	Capacity factor	AEP averaged over the wind farm life at the offshore metering point at entry to offshore substation, as a fraction of AEP if at rated power output all year. Accounts for improvements in early years and degradation in later years. Includes • Aerodynamic array losses • Blockage effect • Electrical array losses • Losses due to unavailability of the wind turbines, foundations, and array cables • Losses from cut-in/cut-out hysteresis, power curve degradation, and power performance loss.	%

Note: A similar set of definitions was used for the fixed project analysis.

Generic definitions

Global assumptions

Real (2020) prices. Exchange rates fixed at the average for 2020 (for example, €1 = US$1.142).

Standard wind farm assumptions

Turbines are spaced at nine rotor diameters (downwind) and six rotor diameters (across wind) in a rectangle. The lowest point of the rotor sweep is at least 22 meters above mean high water spring tide. The development and construction costs are funded entirely by the project developer.

Meteorological regime

A wind shear exponent of 0.12. Rayleigh wind speed distribution.

Turbine

The turbine is certified to international OSW turbine design standard IEC 61400-3-1 for fixed and IEC 61400-3-2 for floating cases.

Support structure

Ground conditions are good for OSW. There are only occasionally locations with lower bearing pressure, the presence of boulders, or significant gradients.

Array cables

The array cable assumption is that a three core 66 kVAC on fully flexible strings is used, that is, with provision to isolate an individual turbine.

Installation

Installation is carried out sequentially by the mooring, array cable, and then the preassembled tower and turbine together.

Decommissioning reverses the assembly process to result in installation taking one year. Piles are cut off at a depth below the seabed which is unlikely to require uncovering and cables are pulled out. Environmental monitoring is conducted at the end. The residual value and cost of scrapping is ignored.

Transmission

Transmission costs are incurred as CAPEX and OPEX where appropriate. This treatment of transmission costs reflects the actual costs of building and operating, rather than the costs incurred by the asset owner.

Operations, maintenance, and service

Access is by SOVs or CTVs. Dynamic positioning vessels are used for major component replacement. Transmission OPEX covers both maintenance costs and grid charges.

11. SUPPLY CHAIN ANALYSIS

11.1 PURPOSE

In this work package, we assessed the supply chain for OSW in the Philippines, including an analysis of current in-country capabilities and opportunities for future investment under the two scenarios presented in Section 2.

We focus on OSW supply chain needs as this will be the dominant project type in the Philippines, covering fixed project needs in less depth. Ports are covered in Section 19.

We also explore potential bottlenecks that could slow the industry in each of the scenarios. This analysis is important as it underpins the work on cost reduction and economic benefits in Sections 10 and 12.

11.2 METHOD

We established a categorization of the supply chain and robust criteria for assessing capability. These are presented in Table 11.1 and Table 11.2. The level 2 categories broadly correspond with the packages used for principal suppliers (also known as tier 1 suppliers) if a developer is multi-contracting.

TABLE 11.1 CATEGORIZATION OF THE SUPPLY CHAIN

Project development	Project development	Work by the developer and its supply chain including planning consent, front-end engineering and design, project management, and procurement
Turbine	Nacelle, hub, and assembly	Supply of components to produce the ex-works nacelle and hub and their delivery to the final port before installation
	Blades	Supply of finished blades and their delivery to the final port before installation
	Tower	Supply of tower sections and their delivery to the final port before installation
Balance of plant	Foundation supply	Supply of foundations and their delivery to the final port before installation
	Array and export cable supply	Supply of cables and their delivery to the final port before installation
	Offshore substation supply	Supply of the completed offshore substation platform and foundation ready for installation
	Onshore infrastructure	Supply of components and materials for the onshore substation and the operations base

Level 1 category	Level 2 category	Description
Installation and commissioning[xix]	Turbine and floating foundation installation	Work undertaken in the final port before installation and the installation and commissioning of the turbines and foundations, including vessels
	Array and export cable installation	Installation of the cables, including route clearance, post-lay surveys, and cable termination
	Offshore and onshore substation installation	Installation of the offshore substation and the civil works for the onshore substation. Includes commissioning of electrical system
Operation, maintenance, and service	Wind farm operation	Wind farm administration and asset management, including onshore and offshore logistics
	Turbine maintenance and service	Work to maintain and service the turbines, including spare parts and consumables
	Balance of plant maintenance and service	Inspection and repair of foundations, inspection and repair or replacement of cables, and onshore and offshore substation maintenance and service
Decommissioning	Decommissioning	Removal of all necessary infrastructure and transport to port; excludes recycling or reuse

Source: BVG Associates.

Criteria for assessing capability

We developed a set of criteria for assessing the current and future capability of supply chain in the Philippines. They relate to the likelihood that existing companies in the Philippines can be successful in the industry and that new companies can be attracted to invest in the Philippines. The scoring relates to the general capability of the supply chain at the country level and is not based on a detailed analysis of individual companies. The scoring is based on an appreciation of global OSW supply chain capability and an understanding of the factors that are key to successfully localizing OSW supply chains. Further work is required in due course to undertake supply chain assessment at a detailed company level.

These criteria were scored for each level 2 category, as shown in Table 11.2. In the analysis, we distinguished between principal suppliers (equivalent to tier 1) and lower tier suppliers. We shared this assessment with key stakeholders (see Section 22) and gathered feedback and additional data, as well as views on bottlenecks, recognizing the Philippines' place in the regional and global market.

xix The manufacturing of vessels for OSW could be an opportunity for the supply chain in the Philippines, but was not considered in this analysis as they are not a direct supply item for any given OSW project.

TABLE 11.2 CRITERIA FOR ASSESSING CURRENT AND FUTURE CAPABILITY IN THE PHILIPPINES

Criterion	Score	Description
Track record and capacity in OSW	1	No experience
	2	Experience in supplying wind farm ≤300 MW
	3	One company with experience of supplying wind farm >300 MW
	4	Two or more companies with experience of supplying wind farm >300 MW
The Philippines capability in parallel sectors	1	No relevant parallel sectors
	2	Relevant sectors with relevant workforce only
	3	Companies in parallel sectors that can enter market with high barriers to investment
	4	Companies in parallel sectors that can enter market with low barriers to investment
Benefits of the Philippines supply for the Philippines projects	1	No benefits in supplying projects in the Philippines from the Philippines
	2	Some benefits in supplying projects in the Philippines from the Philippines but no significant impact on cost or risk
	3	Work for projects in the Philippines can be undertaken from outside the Philippines but only with significant increased cost and risk
	4	Work for projects in the Philippines must be undertaken locally
Investment risk in the Philippines	1	Investment that needs market certainty from OSW for five or more years
	2	Investment that needs market certainty from OSW for two to five years
	3	Low investment ≤US$50 million that can also meet demand from other small sectors
	4	Low investment ≤US$50 million that can also meet demand from other major sectors with market confidence
Size of the opportunity	1	<2% of lifetime expenditure
	2	2%≤3.5%
	3	3.5–5%
	4	>5% of lifetime expenditure

Source: BVG Associates.

11.3 RESULTS

Summary

Table 11.3 summarizes our analysis. Some categories have been considered together to avoid duplication. The sections below discuss our findings in more detail.

The regional market, as discussed in Section 8.4, also offers the opportunity to access what will be an experienced regional supply chain by the late 2020s, in both fixed and floating OSW.

The list of notable relevant companies is indicative and not exhaustive. Many global players are expected to be active in the market as it establishes—those are not listed. We have listed some companies active in the global OSW market that are already known to be present in the Philippines and local companies with relevant capability, some of which have shown interest. Scoring relates to general capability at the country level and not to individual companies.

TABLE 11.3 SUMMARY OF THE SUPPLY CHAIN ANALYSIS

Category	Notable relevant local companies*	Track record and capacity in OSW	Capability in parallel sectors	Benefits of local supply	Investment risk in the Philippines	Size of the opportunity
Project development	Aecom, AFRY, Arup, GHD, Jacobs, Tractebel-Engie and others	1	4	4	4	2
Nacelle, hub, and assembly		1	1	2	1	4
Blades		1	1	3	1	4
Tower	Atlantic Gulf and Pacific Company (AG&P), EEI Corporation, Keppel, Fluor	1	2	3	2	3
Foundation supply	AG&P, Bauer, EEI, Keppel, Fluor	1	3	3	2	4
Array and export cable supply		1	1	1	1	3
Offshore substation supply	AG&P, EEI, Keppel, Fluor	1	2	2	3	2
Onshore infrastructure	EEI, First Balfour, JGC Philippines, Sta. Clara, Grandspan Development Corporation	2	4	4	4	2
Turbine and floating foundation installation	Keppel, Swire	1	2	2	2	2
Array and export cable installation		1	2	1	2	4
Offshore and onshore substation installation	First Balfour, Sta. Clara, then same as turbine installation above	1	2	2	2	2
Wind farm operation	AC Energy, UPC Renewables	1	2	4	3	3
Turbine maintenance and service		1	2	4	4	4
Balance of plant maintenance	AC Energy, KEPCO Philippines, EDC, UPC Renewables	1	2	3	3	3
Decommissioning	Same as installation	1	2	1	2	2

Note: *A local supplier is one which would deliver most of the work for the project in the Philippines. It includes foreign headquartered companies operating in the Philippines
Source: BVG Associates.

Opportunities

The analysis shows that while there is little direct experience, there is some relevant capability in most parts of the supply chain. The main opportunities lie where

- There is capability;
- There is logic in supplying Philippines projects from the Philippines (which is sensitive to the growth scenario); and
- The investment risk is lowest.

The opportunity is therefore greatest in categories such as project development, onshore infrastructure, tower, foundation, and offshore substation supply (specifically, topside and foundation manufacture and substation assembly), and in the operations and maintenance phase.

The OSW industry is highly cost-sensitive and typically views competition on a global basis for many categories of supply. This means that local suppliers will need to work hard to learn and compete, with international collaboration likely key to success.

Table 11.4 shows the likely changes in supply chain in the Philippines in the low and high growth scenarios. The high growth scenario creates a stronger logic for the Philippines supply and lowers market risk. We anticipate that most strategic investments will happen before 2030. This is because by this time the regional supply chain will have matured and it will become increasingly difficult to attract new inward investment, unless to extend existing facilities.

TABLE 11.4 CHANGE IN THE PHILIPPINES SUPPLY CHAIN IN LOW AND HIGH GROWTH SCENARIOS

	Low growth	High growth
	2030	2030
Project development	↗	↗
Turbine	→	↑
Foundations	→	↑
Cables	→	→
Installation	↗	↗
OMS	↗	↗

(key: → = minimal change; ↗ = organic growth; ↑ = growth via significant inward investment)
Source: BVG Associates.

Potential bottlenecks

Due to supply from overseas and a rapidly growing global market, the Philippines will compete with other markets for supply of key items. Should it be more attractive for key global suppliers to serve other markets, the Philippines risks delays to projects due to supply bottlenecks. Attractiveness of a market relates to

- Margin available;
- Long-term potential; and
- Ease of doing business, without additional local certifications and standards to meet beyond the normal international requirements.

Historically, there have been times where key items including wind turbines, subsea cables, and jack-up installation vessels for fixed projects have been limited. All areas of the supply chain continue to invest to meet anticipated future demand, but there remains a risk of bottlenecks that is best managed by experienced, globally acting project developers.

Project development

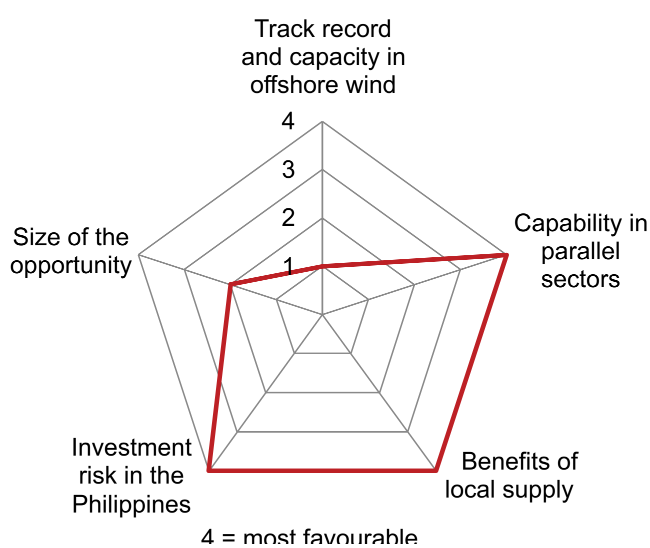
Project development is likely to be led by established OSW developers, potentially with a local partner, and the work is likely to be split between a local office and the locations of an international partner, drawing on the

- Local partner for in-country knowledge and relationships and
- International partner for its project management, engineering, environmental management and procurement skills, and OSW experience and relationships.

There are no OSW farms in the Philippines yet, but there is capability in parallel sectors from the development of onshore wind farms and other power generation project.

There are benefits of using a local supply chain during development because these companies will have a good understanding of relevant local regulations and local companies can minimize logistics and labor costs. It is, however, likely that the local supply chain will need some capacity building and support from international operators when it comes to undertaking ESIA to GIIP for OSW. The barriers to entry are low, with investments mainly in skills to meet the needs of OSW. These conclusions are summarized in Figure 11.1.

FIGURE 11.1 ASSESSMENT OF SUPPLY CHAIN FOR PROJECT DEVELOPMENT



Source: BVG Associates.

Turbine

With the involvement of global developers, we anticipate that wind farms in the Philippines will use the turbine suppliers that dominate the European and US markets, since these are likely to offer the lowest cost of energy. Chinese suppliers may start to supply to the region, but so far there has been little evidence of appetite for this, with a continued strong focus on serving their home market.

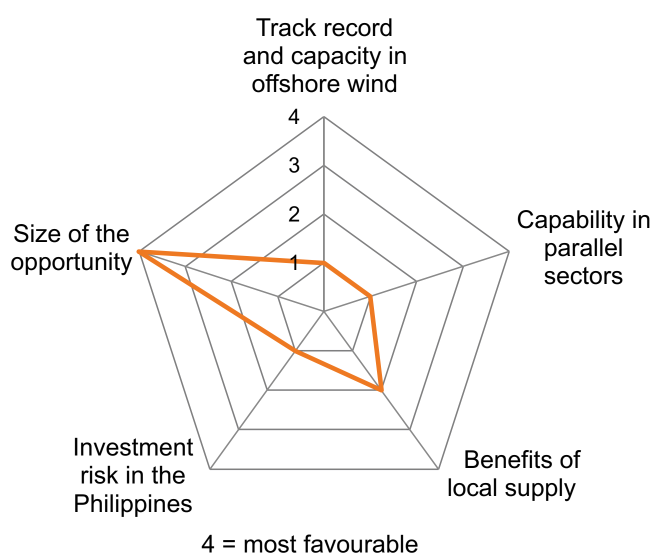
Nacelle, hub, and assembly

The Philippines has no turbine manufacturing facilities currently, and it is unlikely that there is a business case for investment in country even in the high growth scenario. While there is some benefit to local supply to minimize transport costs, nacelles and hubs have complex supply chains and components that are critical to turbine performance and reliability, and so the barriers to investment are high. It is therefore likely that nacelles and hubs will be imported.

Political and market considerations have driven investment in a nacelle assembly factory by Siemens Gamesa in Taiwan, China and General Electric is committed to a factory in Guangdong province, China. General Electric and Vestas have announced plans for construction of nacelle assembly facilities in Japan. It is not likely that leading wind turbine suppliers will establish many sets of facilities in East and Southeast Asia. The opportunity for the Philippines is low.

These conclusions are summarized in Figure 11.2.

FIGURE 11.2 ASSESSMENT OF SUPPLY CHAIN FOR NACELLE, HUB, AND ASSEMBLY



Source: BVG Associates.

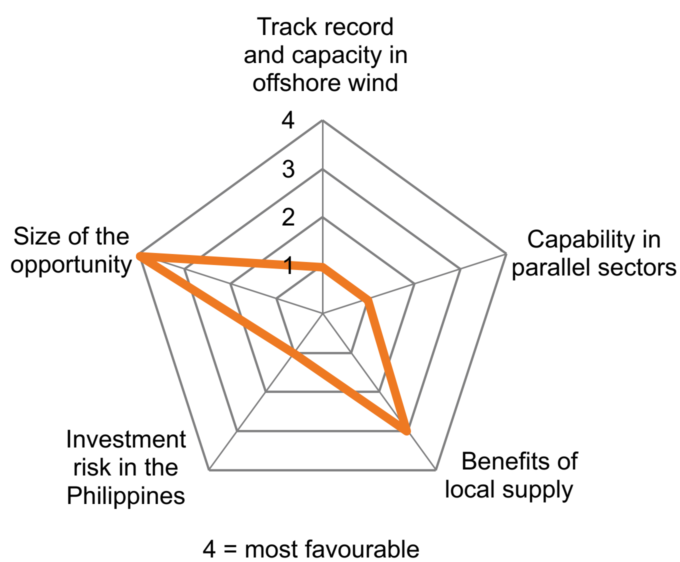
Blades

Currently, the Philippines has no blade production facilities. While transport costs of blades are high, and manufacture is relatively easy to localize as its supply chain is mostly materials from commodity suppliers, investment risk is high and there is not much relevant capability in parallel sectors in the Philippines. Typically, a blade manufacturing facility serves only one turbine supplier and is established by (or in close partnership with) the turbine supplier due to intellectual property considerations.

Given the growing OSW market in the region, global turbine suppliers are likely to invest in East/Southeast Asian manufacturing facilities, but it is more likely to be in neighboring countries with more relevant experience and earlier entry into OSW. MHI Vestas and Siemens Gamesa have made commitments to Taiwan, China.

These conclusions are summarized in Figure 11.3.

FIGURE 11.3 ASSESSMENT OF SUPPLY CHAIN FOR BLADES



Source: BVG Associates.

Tower

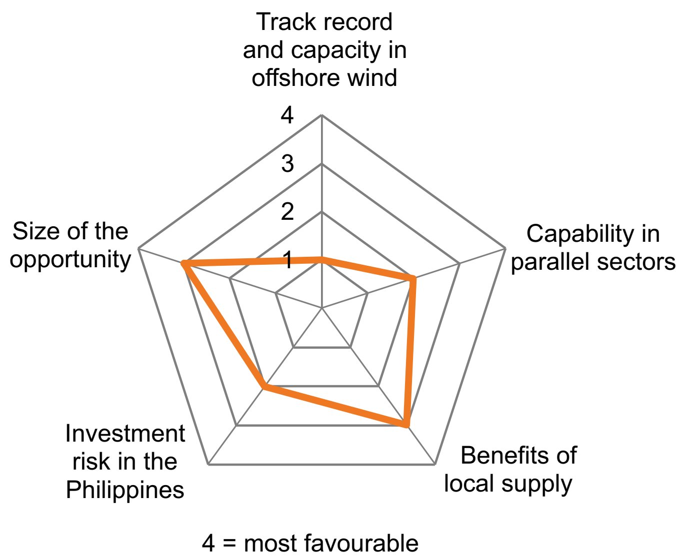
There are no tower production facilities in the Philippines currently.

There is logistical benefit to local supply due to high transport costs, and the supply chain for towers is not complex, so in the high growth scenario there could be a business case for a tower production facility in the Philippines, despite high investment risks. Such a facility could supply any of the wind turbine suppliers in the market.

Tower production is largely automated, and the Philippines has a suitably qualified workforce for tower production. A new facility could also support the onshore wind market and potentially some exports as well.

These conclusions are summarized in Figure 11.4.

FIGURE 11.4 ASSESSMENT OF SUPPLY CHAIN FOR TOWERS



Source: BVG Associates.

Balance of plant

Foundation supply

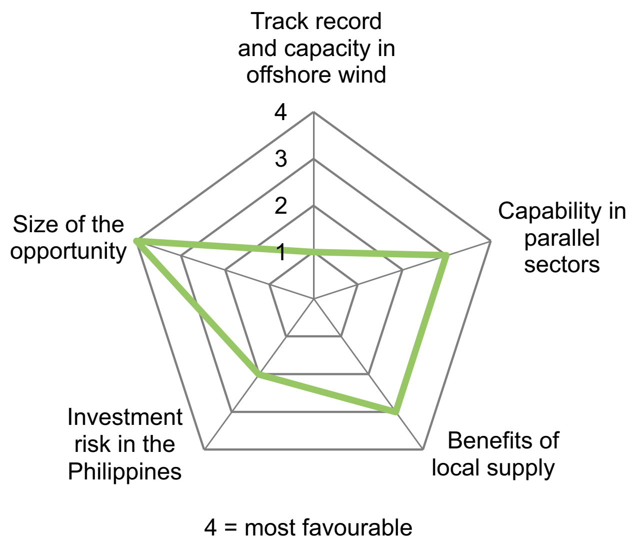
In both the low and the high growth scenarios, we expect that the first few projects in the Philippines will use mainly monopile (and possibly some jacket) foundations fixed to the seabed in the shallower sites, but from 2032 most (if not all) projects installed will use floating foundations, as most of the suitable areas for OSW in the Philippines are in deeper waters.

Although the transport costs for monopile foundations are high, it is unlikely that there is a business case for investment in the rolling equipment needed to manufacture monopiles in country due to the low volume of fixed foundations needed and high investment needed for a potentially short period of supply. There is a stronger benefit of local supply for jacket foundations as it is less automated, and the Philippines have a suitably qualified workforce. It is unlikely, however, there will be a high enough demand for jackets even in the high growth scenario to make a business case for investment.

The majority of the future demand for foundations is likely to be for floating foundations, made from either steel or concrete. There is some relevant capability from parallel sectors for both, and the demand in the high growth scenario is enough to make the business case for investment, despite the relatively high investment needed to establish an internationally competitive facility. Any facility will be able to supply a range of different designs and may be best established in partnership with suppliers with experience at that point in fixed or floating foundation supply. At least until the mid-2030s, some such designs will be based fully on the use of steel. Others are likely to be based on the use of reinforced concrete. The market may in time establish a leading design concept, but commodity prices and national market-specific considerations may lead to a range of solutions continuing to be used globally, long term. We have assumed in our analysis that in the high growth scenario two-thirds of floating foundations will be manufactured in country. Although the conclusion to the supply chain analysis is the same for both scenarios, the market size in the low scenario is unlikely to be high enough for investment in local supply of foundations.

The conclusions for the supply of floating foundations are summarized in Figure 11.5.

FIGURE 11.5 ASSESSMENT OF SUPPLY CHAIN FOR FOUNDATIONS



Source: BVG Associates.

Array and export cable supply

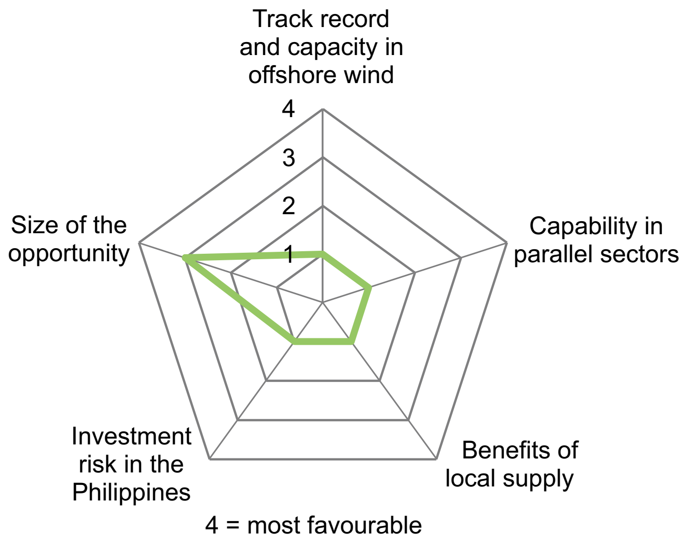
The Philippines has no subsea cable production capability currently. The logistical benefits are low because in many cases a single cable vessel can transport all the cable for a project from the factory in one or two journeys. There are subsea cable factories in China, Japan, and Korea, as well as outside the region, and these are likely to be used for projects in the Philippines.

As the East/Southeast Asian market grows, new investment is likely to be necessary, but cable suppliers typically seek to expand existing facilities rather than invest at new sites. This is because long lead times for new factories with low market certainty mean a significant investment risk.

The investment risk for export cables is lower than for array cables, as there will be a market for interconnectors in the Philippines. Despite this, it is unlikely that there is a business case for investment in the Philippines in array and export cable supply.

These conclusions are summarized in Figure 11.6.

FIGURE 11.6 ASSESSMENT OF SUPPLY CHAIN FOR ARRAY AND EXPORT CABLES



Source: BVG Associates.

Offshore substation supply

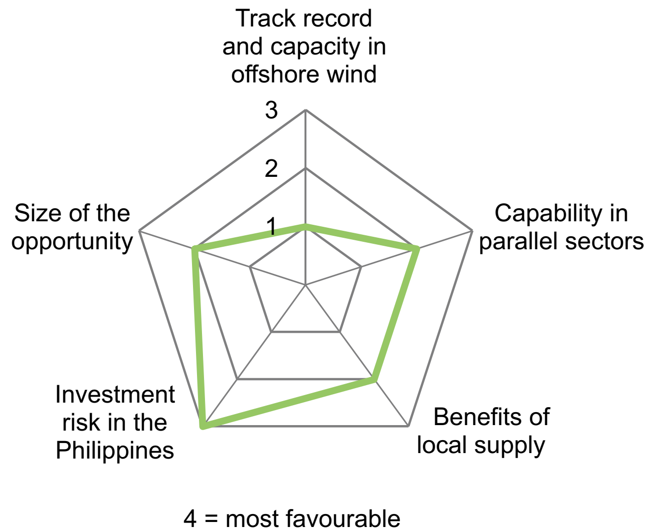
OSW substation supply has synergies with shipbuilding as it requires steel fabrication and systems integration skills. Substations are typically one-off designs and therefore new entrants do not need to make investments to enable efficient volume production. A challenge for new entrants has been the lower profit margins in OSW than in the oil and gas sector, for example.

There is benefit to local supply of the substation foundations and topsides, and in the high growth scenario we have assumed that investing in manufacturing of floating turbine foundations would also bring manufacturing of substation foundations and topsides. For systems integration the Philippines has some relevant experience from the shipbuilding industry.

An offshore substation platform for the Philippines could also draw on local supply chain for items such as secondary steel, platforms and walkways, cable trays, and auxiliary and low voltage systems. High voltage equipment is likely to be imported from global suppliers such as Hitachi ABB, GE Grid Solutions, and Siemens Energy. The OSW industry is typically too small to drive electrical equipment manufacturing investments in new locations.

These conclusions are summarized in Figure 11.7.

FIGURE 11.7 ASSESSMENT OF SUPPLY CHAIN FOR OFFSHORE SUBSTATIONS



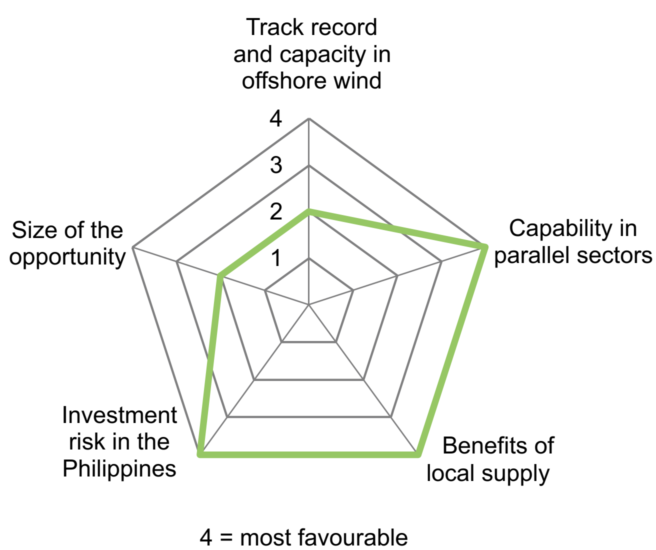
Source: BVG Associates.

Onshore infrastructure

Onshore infrastructure includes the onshore export cable, the onshore substation, and the operations base. There are significant synergies with the rest of the civil engineering sector and this work is typically provided by local companies. No significant investment by local companies is likely to be necessary. For the substation the electrical equipment is likely to be imported.

There is no difference between the scenarios. Figure 11.8 summarizes these conclusions.

FIGURE 11.8 ASSESSMENT OF SUPPLY CHAIN FOR ONSHORE INFRASTRUCTURE



Source: BVG Associates.

Installation and commissioning

Turbine and foundation installation

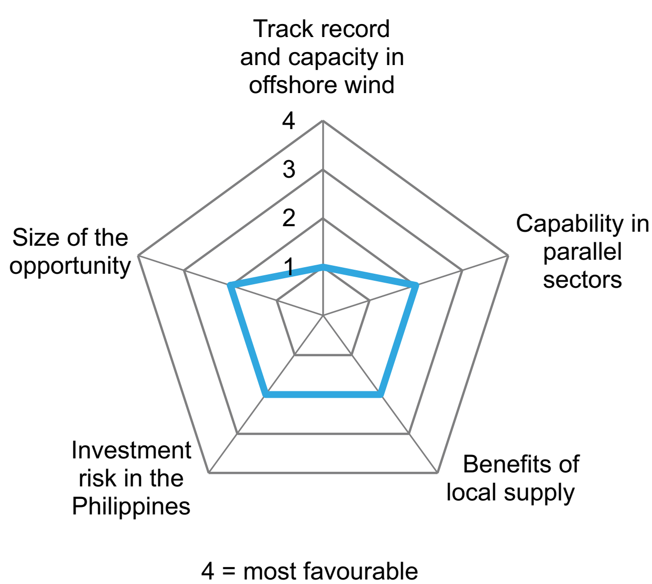
Fixed OSW farms use specialist jack-up vessels built almost exclusively for OSW use to install the turbines. Fixed foundations are usually installed by either a jack-up vessel (which may also be used for turbines) or a floating heavy lift vessel. The Philippines has no such vessels, so they are likely to be supplied, along with most of the crew, from elsewhere for the small volume of fixed projects anticipated in each scenario.

For floating OSW farms, it is likely that the turbines will be assembled onto the floating foundation hull at a local port and then the floating turbine-hull system gets towed out to site and connected to preinstalled moorings and cabling. This eliminates the need for heavy lift vessels and uses service vessels and tugs instead. Some of these might be local, but the majority will come from overseas. There is benefit in using local vessels for tug and other support operations, if available.

Regardless of the installation solution adopted for OSW farms in the Philippines, local ports and services will be used in both scenarios, although the work may be undertaken by an experienced OSW marine contractor. Local maritime crew will be used for local vessels.

Figure 11.9 summarizes our conclusions for floating OSW farms.

FIGURE 11.9 ASSESSMENT OF SUPPLY CHAIN FOR TURBINE AND FOUNDATION INSTALLATION



Source: BVG Associates.

Array and export cable installation

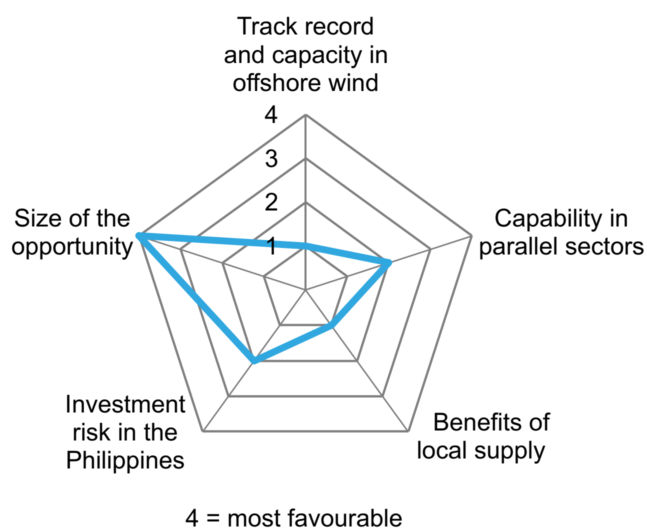
Array and export cable installation may use the same vessels and equipment, but optimal solutions differ. Array cable laying vessels need to be maneuverable, but do not need high carrying capacity. Export cable laying vessels are typically larger to carry the full length of an export cable. Ideally, they can also operate in shallow water for installation up to the shoreline. The Philippines has no such vessels stationed locally.

OSW cable laying is technically challenging, particularly the process of pulling in and terminating the cable at the base of the turbine, and the risks of entering the market are significant; as well as the investment in vessels, inexperienced cable laying companies have suffered project delays in established OSW markets and the financial consequences can be severe.

With little benefit to local supply and high investment risk, it is unlikely that there is a business case for investment on cable laying vessels in the Philippines. Some of the marine crew and most port services could, however, be local.

Figure 11.10 summarizes our conclusions.

FIGURE 11.10 ASSESSMENT OF SUPPLY CHAIN FOR ARRAY AND EXPORT CABLE INSTALLATION



Source: BVG Associates.

Offshore and onshore substation installation

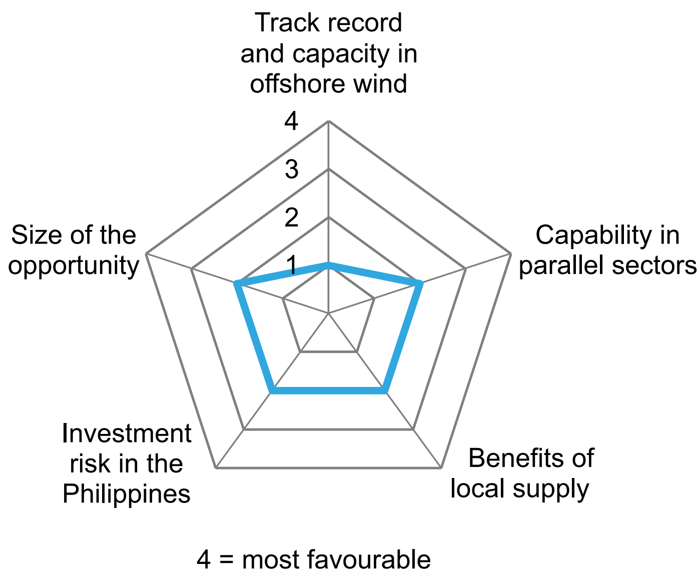
For fixed projects in shallower water, the offshore substation foundation is often a jacket, but can be a monopile. In these cases, offshore substation installation consists of the installation of the foundation (as above) and then the substation topside. The substation topside is likely to weigh more than 2,000 t and in most cases is transported to site by barge then lifted into position by a large, heavy lift vessel. There are no such vessels in the Philippines.

Deeper water, floating OSW farms are likely to use floating substations, towed to preinstalled moorings. Floating installation, therefore, is likely to use service vessels and large tugs. Some of these vessels might be local, but the rest are likely to come from overseas.

For onshore substation installation there are significant synergies with the rest of the civil engineering sector and the Philippines has suitable expertise to undertake the work.

Figure 11.11 summarizes our conclusions.

FIGURE 11.11 ASSESSMENT OF SUPPLY CHAIN FOR OFFSHORE AND ONSHORE SUBSTATION INSTALLATION



Source: BVG Associates.

Operations, maintenance, and service

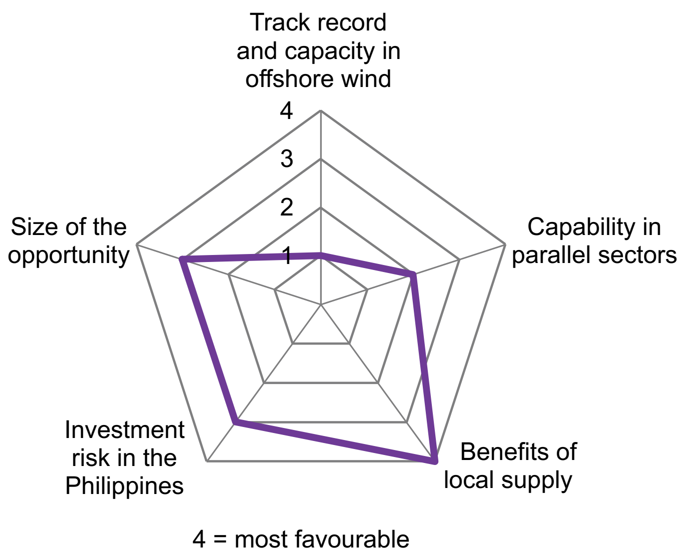
Wind farm operation

Wind farm operation combines asset management expertise from onshore wind and large electromechanical infrastructure assets along with offshore logistics. The Philippines has only a limited onshore wind industry, but barriers to entry are generally lower than in many of the capital phase areas described earlier; revenue streams are long term and there is benefit to local supply. It is therefore likely that there will be local asset management combined with global resource used by the wind farm owners and turbine manufacturers.

OSW projects close to shore typically use bespoke CTVs, and these could be built and operated locally, normally from the closest small port to the project. Projects further from shore use larger service operation vehicles that will be locally crewed and have a local home port.

Figure 11.12 summarizes our conclusions.

FIGURE 11.12 ASSESSMENT OF SUPPLY CHAIN FOR WIND FARM OPERATION



Source: BVG Associates.

Turbine maintenance and service

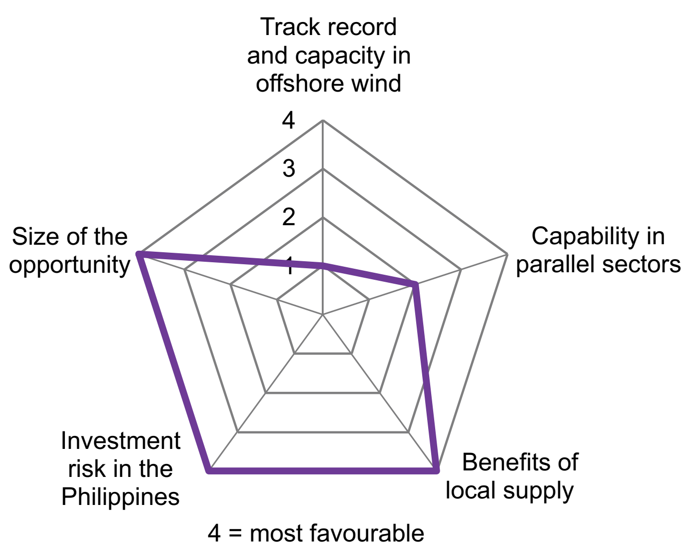
Turbine maintenance and service is typically undertaken by the turbine supplier, generally under a service agreement of length up to 15 years, or by experienced international project developers who go on to be lead owners of projects. A local workforce will be used for much of the work, and there is an opportunity for local companies offering inspection services and technicians during planned maintenance and unplanned service activities in response to turbine faults. The barriers to entry are lower than in many of the capital phase areas described earlier, and investment will be mainly focused on ensuring a high-quality skills base. In the early days of operation there is likely to be a significant number of overseas technicians used, but the numbers will decline as a local workforce is trained.

Major replacements for fixed OSW projects typically use the same large jack-up vessels used in installation. For floating projects, it is anticipated that the turbine-hull systems will be towed back to a construction port for major replacements and repairs, though in time, alternative in situ solutions may be introduced. When towing to shore, it is expected to hot swap in a replacement turbine, rather than leave a location without generation for a long period. We expect that some local tugs will be used, but the majority will be imported from overseas.

Spare parts and consumables will be imported in the absence of any wind manufacturing supply chain in the Philippines, due to the importance of using proven, reliable products. There may be some opportunity for local refurbishment of some components.

Figure 11.13 summarizes our conclusions.

FIGURE 11.13 ASSESSMENT OF SUPPLY CHAIN FOR TURBINE MAINTENANCE AND SERVICE



Source: BVG Associates.

Balance of plant maintenance and service

Balance of plant maintenance and service covers foundations, array cables, export cables, and substations.

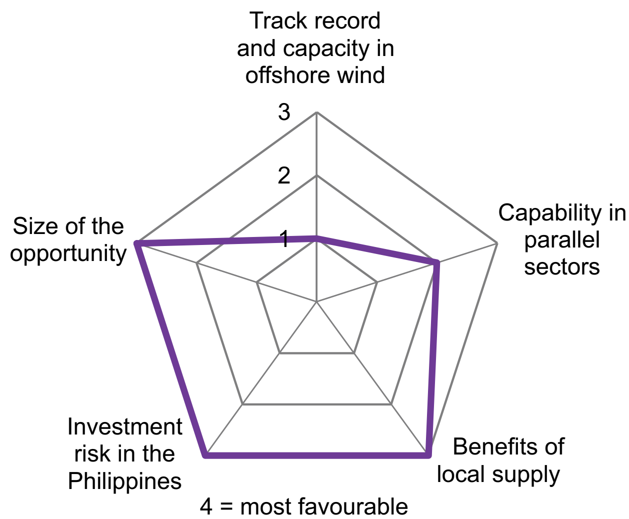
Cable maintenance and service is the most significant, with cable failures the biggest source of insurance claims in OSW, typically due to mechanical damage caused to the cables. It uses equipment similar to cable installation, in some cases with cables replaced and in others with cables repaired in situ.

Foundation maintenance and service includes inspections for corrosion or structural defects above and below the water line, and cleaning and repairing areas especially around the water line. This is likely to use a mix of expert global workforce to diagnose problems and define solutions and local workforce to implement. For floating foundations, this may involve towing to shore.

For substations some of the structural maintenance and service could be done by local workforce, but the electrical system component replacements are likely to come from global suppliers.

Figure 11.14 summarizes our conclusions.

FIGURE 11.14 ASSESSMENT OF SUPPLY CHAIN FOR BALANCE OF PLANT MAINTENANCE AND SERVICE



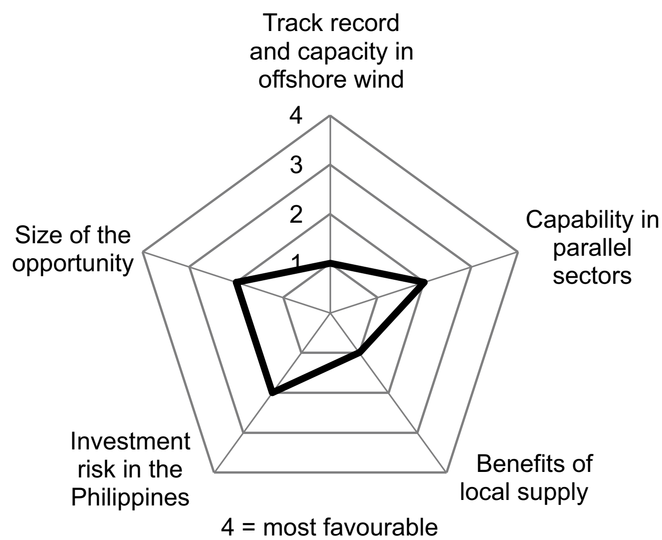
Source: BVG Associates.

Decommissioning

Although some decommissioning has been carried out in established markets, solutions have not yet been optimized. It is most likely that vessels that have been used for installation will also support decommissioning, following similar processes, with some simplifications. Much material can be recycled, offering opportunities in the circular economy. As projects start reaching end of life, there will also be work exploring extension of life of generating and/or transmission assets.

Figure 11.15 summarizes our conclusions.

FIGURE 11.15 ASSESSMENT OF SUPPLY CHAIN FOR DECOMMISSIONING



Source: BVG Associates.

11.4 DISCUSSION

The Philippines has good port infrastructure that could host local manufacturing. It has supply chain capability relevant to some areas of OSW. A proactive approach will help increase local readiness for supply and help create the economic benefit discussed in Section 12. The regional market, as discussed in Section 8.4, also offers the opportunity to access what will be an experienced regional supply chain by the late 2020s, in both fixed and floating OSW.

The Government of the Philippines has the opportunity to develop a high-volume market by providing a robust policy framework and good market visibility. International experience shows this to be an effective way to generate local economic benefit without having to resort to restrictive local content requirements.[xx] It is also the dominant way to reduce the cost to consumers and create a more sustainable, internationally competitive supply chain.

11.5 RECOMMENDATIONS

Based on this analysis, the following are recommended:

- DOE, working with the DTI, presents a balanced vision for local supply chain development, encouraging international competition, and enables education and investment in local supply chain businesses, including in training of onshore and offshore workers.
- Learning from elsewhere, the government avoids restrictive local content requirements that add risk and cost to projects and slow deployment.

xx As discussed in Section 2 of the World Bank Group's *Key Factors* report,[3] protectionist practices have not delivered value-added outcomes. They typically drive inefficiency and are not compatible with global OSW businesses managing cost and risk across portfolios of projects.

12. JOBS AND ECONOMIC BENEFIT

12.1 PURPOSE

In this work package, we determine the economic impact of OSW in the Philippines, looking at the potential for job creation and direct investment in the country's OSW industry under the scenarios established in Section 2.

The analysis looks at opportunities at different stages of the industry (including manufacturing, installation, operation, and maintenance), both for in-country projects and export.

This analysis is important as it is helpful to understand, long term, what the economic impact of OSW is and how to maximize this.

The analysis aimed to establish the economic impacts created by wind farms in the Philippines globally and in-country.

12.2 METHOD

We considered three types of impact:

- Total impacts from projects in the Philippines
- Philippines impacts from projects in the Philippines
- Philippines impacts from projects in the Philippines and overseas.

Direct and indirect impacts were modelled. Direct impacts are defined as those associated with project developers and their main contractors. Indirect impacts are defined as those associated with their sub-suppliers.

All cost data are from Section 10, ensuring that the different types of analysis presented are consistent. Section 10 uses the supply assumptions presented in this section.

Total impacts from projects in the Philippines

We established the total FTE employment years and GVA by year created for each market scenario if there was 100 percent local content (that is, there is no import of materials, components, and services):

- Low growth scenario (3 GW by 2040 and 5 GW by 2050)
- High growth scenario (20 GW by 2040 and 40 GW by 2050).

We used an in-house model that uses multipliers to convert expenditure to FTE years and GVA. More details of our methodology are provided in Section 12.4.

We calculated the impacts from a single 1 GW floating project in installed in 2033 in the high growth scenario. We also calculated the impacts of the pipeline of projects in each scenario.

Philippines impacts from projects in the Philippines

We established the impacts in the Philippines by considering the current and potential future capability of the supply chain in the Philippines and assessed the likely percentage of local content for each scenario. The capability of the supply chain in the Philippines and opportunities for growth are discussed in Section 11. A non-exhaustive list of notable relevant suppliers is provided in Table 11.3 in Section 11.

Philippines impacts from projects in the Philippines and overseas

This is the sum of the above and anticipated exports. We estimated the potential based on our understanding of the regional and global market and the supply chain in the Philippines and how that will develop in each growth scenario.

12.3 RESULTS

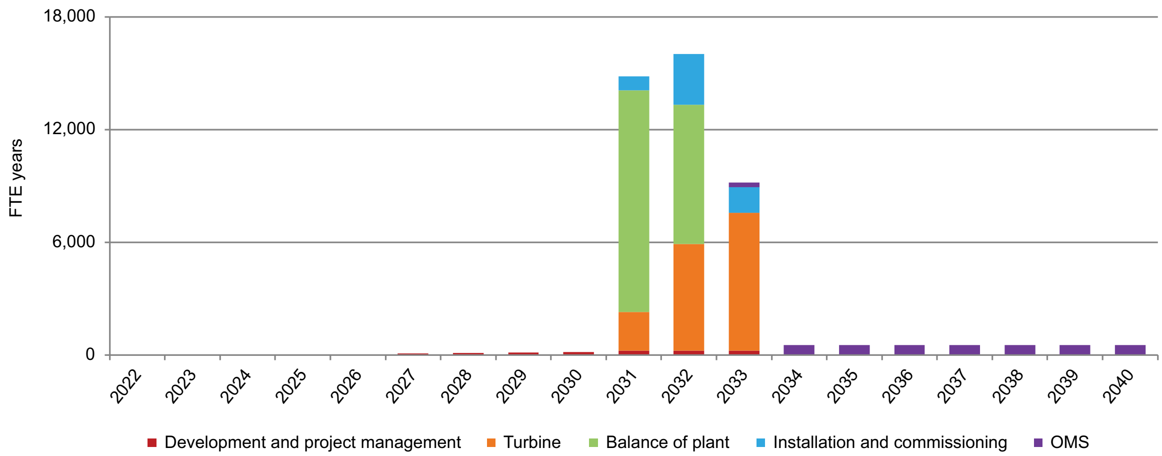
Total impacts from projects in the Philippines

High growth scenario: single project

Figure 12.1 shows the total FTE years of employment created annually for a single 1 GW floating project installed in 2033 in the high growth scenario. It shows that employment peaks in 2032, the first full year of construction at about 16,000 FTE years, when there is significant turbine and balance of plant manufacture as well as installation. Total employment for the project is about 60,000 FTE years over the 30-year lifetime of the project.

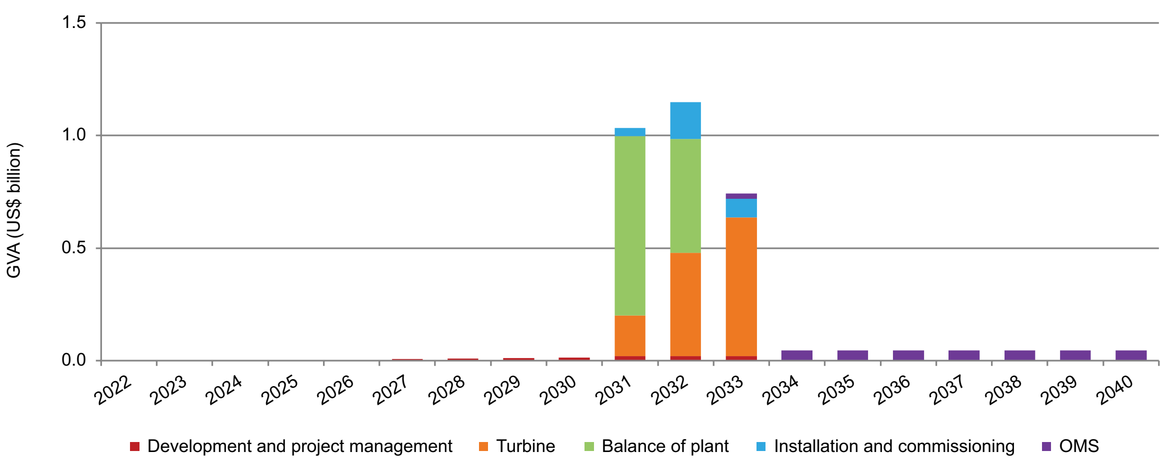
Figure 12.2 shows the GVA generated by this single project. The peak GVA in 2032 is about US$1.1 billion. The total GVA over the lifetime of the project is about US$4.5 billion.

FIGURE 12.1 TOTAL ANNUAL FTE YEARS OF EMPLOYMENT FOR A SINGLE 1 GW PROJECT INSTALLED IN 2033, SPLIT BY COST ELEMENT



Source: BVG Associates

FIGURE 12.2 TOTAL GVA FOR A SINGLE 1 GW PROJECT INSTALLED IN 2033, SPLIT BY COST ELEMENT



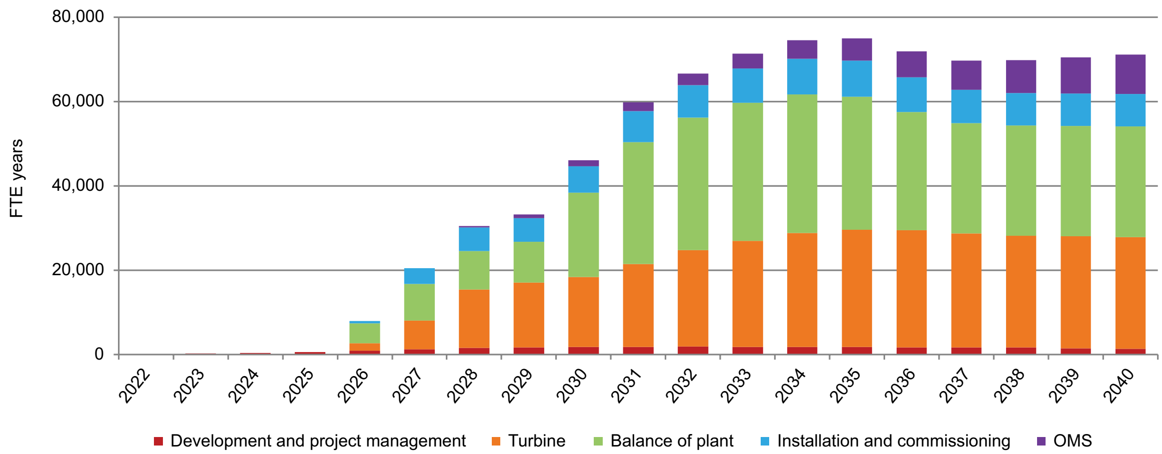
Source: BVG Associates.

High growth scenario

Figure 12.3 shows the global annual FTE years of employment—the number of jobs grow steadily to 2035 where it reaches about 75,000 FTE years per year. The number of jobs decrease for a few years, before plateauing at about 70,000 FTE years per year from 2037. This is because in this scenario although the annual installed capacity reaches a steady state in 2036, some efficiencies are expected in the supply chain, which leads to cost reduction and therefore a small decrease in FTE years. Although there is an increase in OMS jobs after 2035, this is offset by reductions in other parts of the supply chain as a consequence of falling LCOE. Between 2022 and 2040, more than 800,000 FTE years are created.

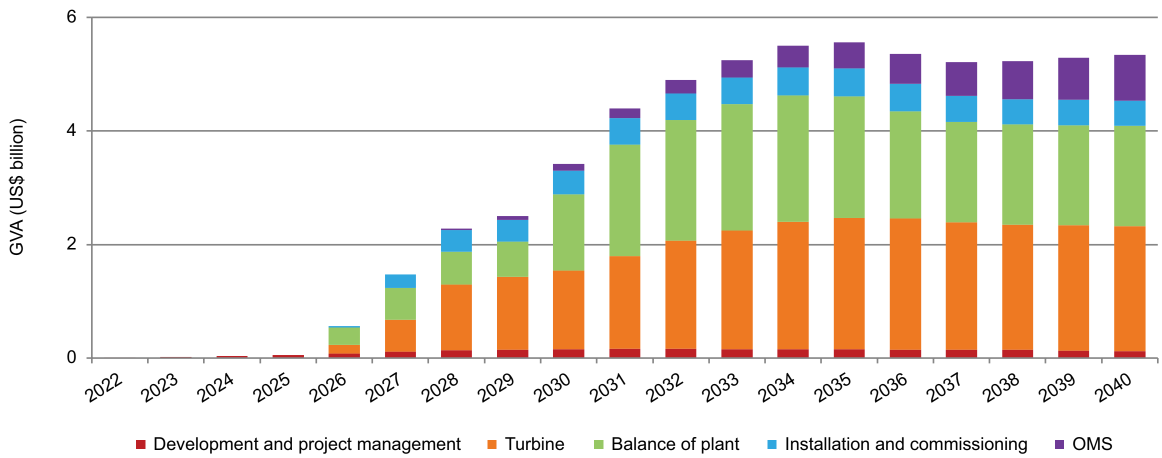
In Figure 12.4, the GVA created by all projects shows a similar pattern, with GVA reaching about US$5 billion per year in the 2030s. Between 2022 and 2040, about US$60 billion GVA is generated.

FIGURE 12.3 TOTAL ANNUAL FTE YEARS OF EMPLOYMENT CREATED BY ALL THE PROJECTS IN THE PHILIPPINES IN THE HIGH GROWTH SCENARIO, SPLIT BY COST ELEMENT



Source: BVG Associates.

FIGURE 12.4 TOTAL GVA CREATED BY ALL THE PROJECTS IN THE PHILIPPINES IN THE HIGH GROWTH SCENARIO, SPLIT BY COST ELEMENT



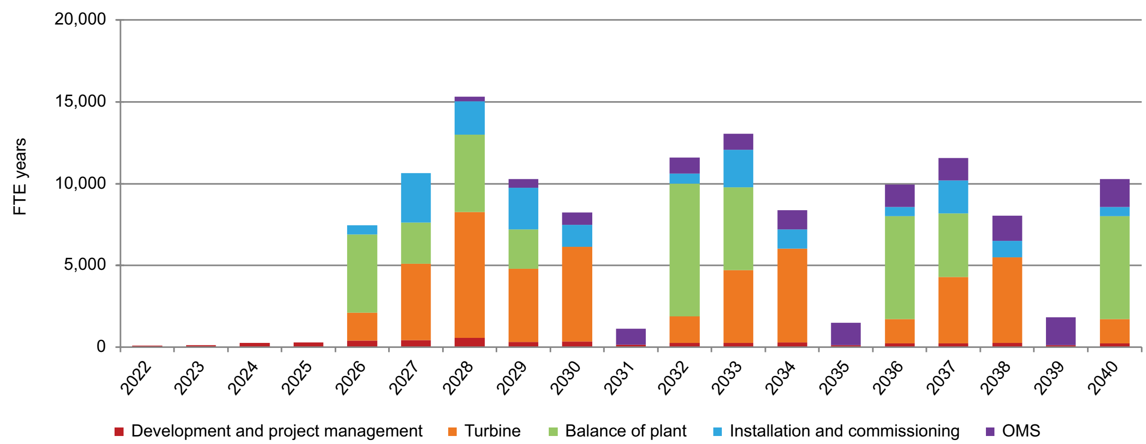
Source: BVG Associates.

Low growth scenario

For the low growth scenario, the pattern is different, as a new project is installed every four years from 2030. Figure 12.5 shows the peaks of about 10,000 FTEs years created in the first full year of construction for each project in. Between 2022 and 2040, more than 130,000 FTE years are created.

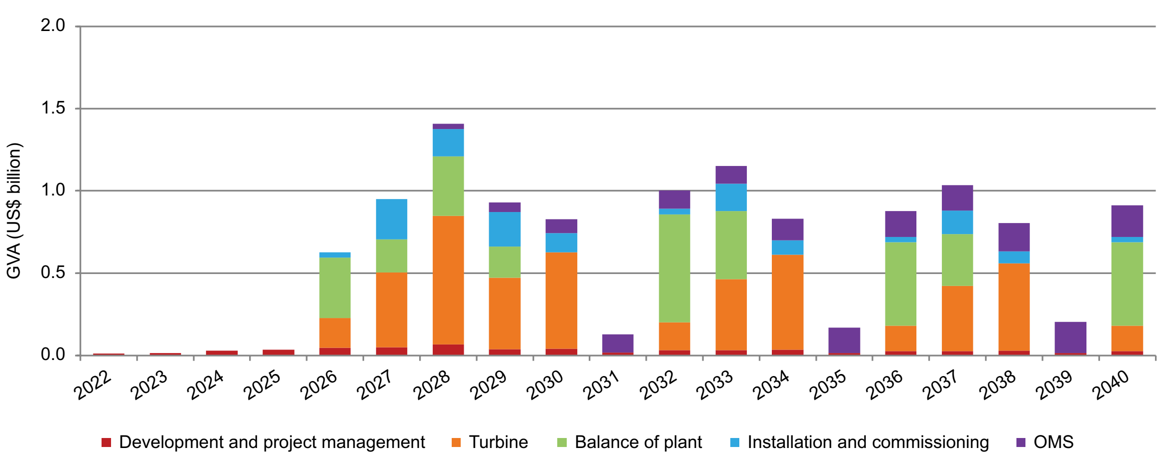
In Figure 12.6 the GVA created by all projects in the low growth scenario shows a similar trend. Between 2022 and 2040, about US$12 billion is generated. This stop-start supply makes it difficult for local suppliers to keep a consistent workforce that grows in OSW experience over time.

FIGURE 12.5 TOTAL ANNUAL FTE YEARS OF EMPLOYMENT CREATED BY ALL THE PROJECTS IN THE PHILIPPINES IN THE LOW GROWTH SCENARIO, SPLIT BY COST ELEMENT



Source: BVG Associates.

FIGURE 12.6 TOTAL GVA CREATED BY ALL THE PROJECTS IN THE PHILIPPINES IN THE LOW GROWTH SCENARIO, SPLIT BY COST ELEMENT



Source: BVG Associates.

Philippines impacts from projects in the Philippines

Table 12.1 shows how the local content changes over time as investments are made. In both scenarios, we show the assumed local content percentage in 2028, 2032, and 2036. These are the year when the first project is installed, the year when the factories in the high scenario are assumed operational, and the year when the annual installed capacity stabilized at around 2 GW in the high growth scenario. The local content percentages reflect the assumptions about the current and future supply chain in the Philippines developed in Section 11. The important differences are that the high growth scenario leads to investment in a tower factory and a floating foundations factory ready for a project in 2032. In general, local content is relatively low, based on the anticipated strength and experience of the regional supply chain by the late 2020s, in both fixed and floating OSW. Note that in some cases, local content drops from one year to the next. This is due to the change in relative cost of different OSW project elements over time, rather than any reduction in scope or fraction of supply.

TABLE 12.1 LOCAL CONTENT FOR THE OSW PROJECTS IN THE PHILIPPINES COMPLETED IN 2028, 2032, AND 2036

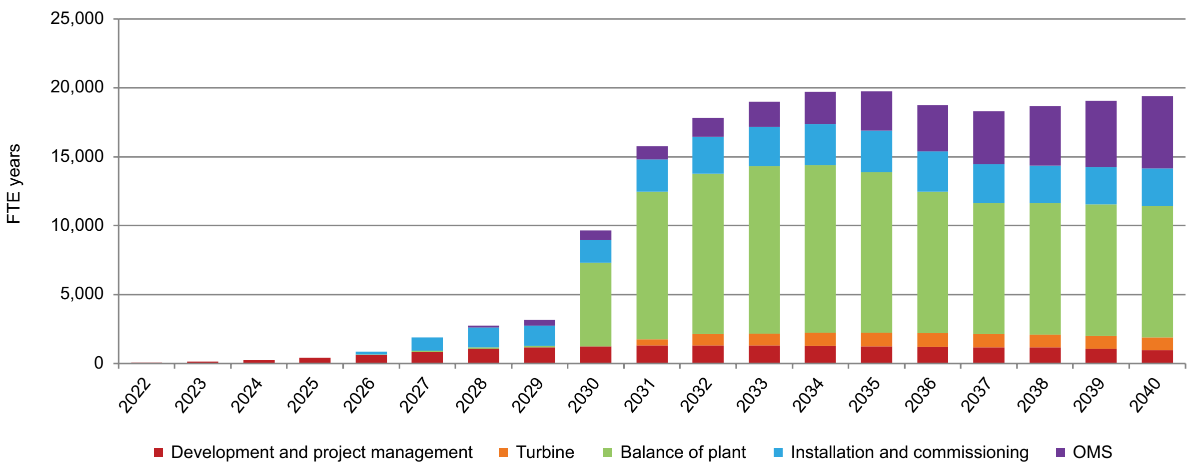
		Low growth (%)			High volume (%)		
		2028	2032	2036	2028	2032	2036
Project development		60	70	70	60	70	70
Turbine	Nacelle, rotor, and assembly	0	0	0	0	0	0
	Blades	0	0	0	0	0	0
	Tower	0	0	0	0	25	25
Balance of plant	Foundation supply	0	0	0	0	40	40
	Array cable supply	0	0	0	0	0	0
	Export cable supply	0	0	0	0	0	0
	Onshore and offshore substation supply	5	5	5	5	40	40
Installation and commissioning	Turbine installation	15	35	35	15	35	35
	Foundation installation	1	35	35	15	35	35
	Array cable installation	5	5	5	5	5	5
	Export cable installation	5	5	5	5	5	5
	Onshore and offshore substation installation	45	45	45	45	45	45
Operation and maintenance	Wind farm operation	80	80	80	80	80	80
	Turbine maintenance and service	25	40	40	40	55	55
	Foundation maintenance and service	40	75	75	60	75	75
	Subsea cable maintenance and service	30	30	30	30	30	30
	Substation maintenance and service	60	60	60	60	60	60
Decommissioning		35	50	50	35	50	50
Total local content (%)		21	20	22	25	36	34

High growth scenario

Figure 12.7 shows annual FTE years of employment created in the Philippines by all projects. It shows that the number of FTE years peaks at about 20,000 in the 2030s. Between 2022 and 2040, 200,000 FTE years are created, about 25 percent of the total created globally by the pipeline of projects in the Philippines.

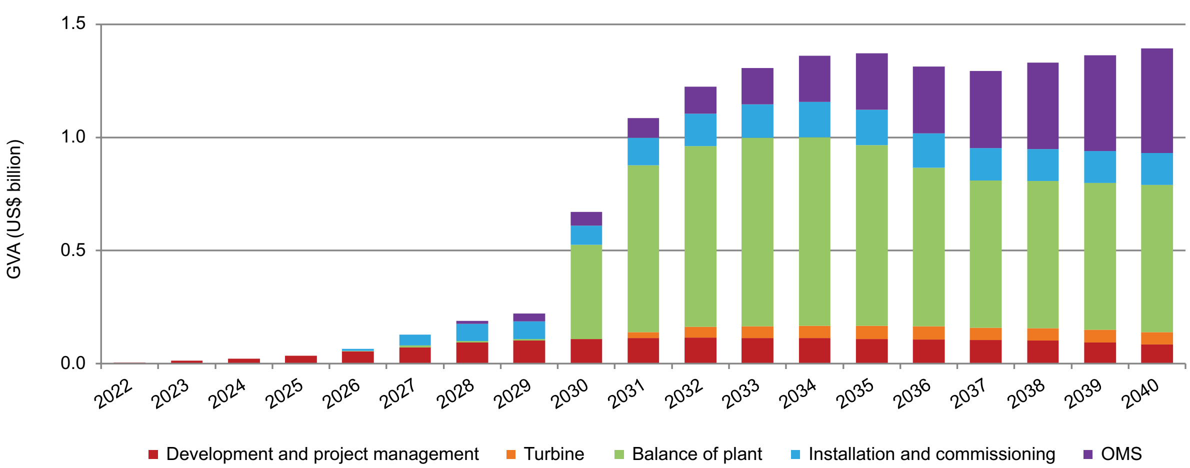
Figure 12.8 shows annual GVA reaching a peak of about US$1.4 billion in the 2030s. Between 2022 and 2040, over US$14 billion GVA is generated, and also about 25 percent of the total generated globally.

FIGURE 12.7 ANNUAL LOCAL FTE YEARS OF EMPLOYMENT CREATED BY ALL THE PROJECTS IN THE PHILIPPINES IN THE HIGH GROWTH SCENARIO, SPLIT BY COST ELEMENT



Source: BVG Associates.

FIGURE 12.8 ANNUAL LOCAL GVA CREATED BY ALL THE PROJECTS IN THE PHILIPPINES IN THE HIGH GROWTH SCENARIO, SPLIT BY COST ELEMENT



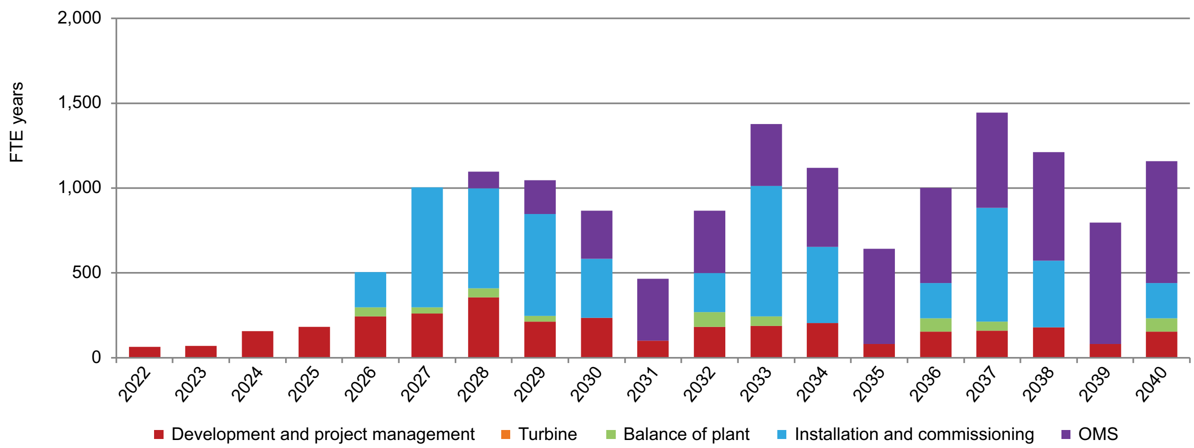
Source: BVG Associates.

Low growth scenario

Figure 12.9 shows the Philippines annual FTE years of employment created by all projects. It shows that the number of FTE years peaks in the first full year of construction for each project in the 2030s, with about 1,100 FTE years. The number of FTE years created between 2022 and 2040 is about 15,000. To aid comparison with the high growth scenario, the same axis scale is used.

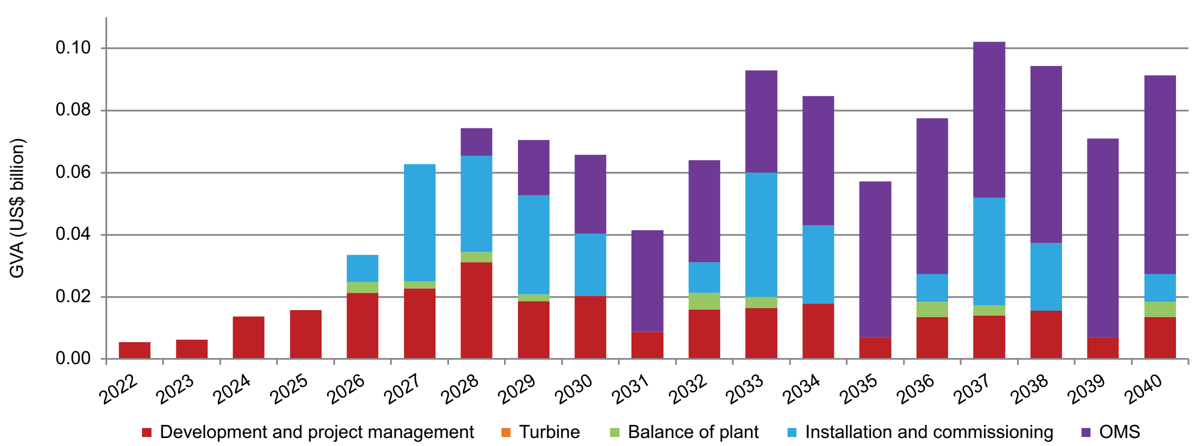
Figure 12.10 shows that annual GVA similarly have peaks of up to US$100 million in the 2030s The GVA generated between 2022 and 2040 is about US$1.1 billion.

FIGURE 12.9 ANNUAL LOCAL FTE YEARS OF EMPLOYMENT CREATED BY ALL THE PROJECTS IN THE PHILIPPINES IN LOW GROWTH SCENARIO, SPLIT BY COST ELEMENT



Source: BVG Associates.

FIGURE 12.10 ANNUAL GVA CREATED BY ALL THE PROJECTS IN THE PHILIPPINES IN LOW GROWTH SCENARIO, SPLIT BY COST ELEMENT



Source: BVG Associates.

Philippines impacts from projects in the Philippines and overseas

In the high scenario we have assumed that 25 percent of the towers manufactured are exported to nearby markets. This creates an additional 4,300 FTE years of employment between 2022 and 2040, as well as US$255 million in GVA. These impacts continue into the 2040s as well.

In the low growth scenario, there are likely to be only minimal opportunities to export.

Investment

Table 12.2 presents the likely large-scale investment needed to deliver the supply chain development described above, with the timeline to achieve impacts for a first floating project installed in 2032. Investments are highly indicative, as they depend on where investment occurs and what existing infrastructure can be used.

Total investment is in the range of US$80–US$250 million in the high growth scenario, with no investments required in the low growth scenario. Smaller-scale investments in the supply chain and investments in ports have not been included, so will be additional.

TABLE 12.2 LOCAL SUPPLY CHAIN INVESTMENTS TO FACILITATE OSW IN THE PHILIPPINES

Investment	Low growth scenario	High growth scenario	Timing	Amount
Turbine towers	Imported	New factory to produce up to 1.5 GW of towers (approx. 1 section per day).	Investment decision in early 2028, supplying the first floating projects.	US$50–100 million
Floating foundations	Imported	2–3 new factories to produce 60–70% of all floating foundations in country.	Investment decision from early 2028 as for first floating projects.	US$30–150 million

Prerequisites

Based on experience in other markets, there are a number of prerequisites to such investment:

- Confidence in a strong visible future pipeline of projects to compete for
- A commercial and financial environment that enables investment, whether inward investment or indigenous
- A sufficient level of commitment to buy a reasonable amount of supply over a long enough period.

In Europe, this last point can be a frustrating barrier, as project developers often only have limited visibility of their own projects and seek to keep competitive tension in their supply chain, so tend not to give much commitment. Often, commitment can only be for 'the next project' and there is not enough time for the supplier to build the new manufacturing facility and then manufacture components because the developer wants to construct the project as soon as possible.

12.4 BACKGROUND: DETAIL OF METHOD

Conventional modelling of economic impacts for most industrial sectors relies on government statistics, for example, those based on industry classification codes and use input-output tables and other production and employment ratios.

Industry classification code data can be appropriate for traditional industries at the national level. The development of new codes for a maturing sector, however, takes time. This means that conventional industry classification analyses of OSW need to map existing data onto OSW activities, which is not easy and a source of error. Analyses using industry classification codes also have to rely on generalized data.

OSW is ideally suited to a more robust approach that considers current and future capability of local supply chains because OSW projects tend to:

- Be large and have distinct procurement processes from one another and
- Use comparable technologies and share supply chains.

It therefore enables a realistic analysis of the local, regional, and national content of projects even where there are gaps in the data.

The methodology used here was developed jointly by BVG Associates and Steve Westbrook of the University of the Highlands and Islands, UK and has been used for a series of major studies.

The methodology's first input is the cost per MW of each of the supply chain categories at the time of wind farm completion.

The remaining expenditure is analogous to the direct and indirect GVA created. GVA is the aggregate of labor costs and operational profits. We can therefore model FTE employment from GVA, provided we understand some key variables. In our economic impact methodology, employment impacts are calculated using the following equation:

$$FTE_a = \frac{(GVA - M)}{Y_a + W_a}$$

Where:
FTEa = Annual FTE employment
GVA = Gross value added (US$)
M = Total operating margin (US$)
Ya = Average annual wage (US$), and
Wa = Nonwage average annual cost of employment (US$).

To make robust assessments, therefore, we consider each major component in the OSW supply chain and estimate typical salary levels, costs of employment, and profit margins, bringing together specific sector knowledge and research into typical labor costs for the work undertaken in each supply chain level 2 category.

FTEs relate to full-time equivalent job years, with part-time or part-year work considered as appropriate. A full-time job would normally be at least 7 hours per day over 230 working days of the year. If an individual works significantly more than this over a year, FTE attribution would be more than 1 FTE (for example, 1.5 FTEs if working long hours over 7 days per week).

FTEs are by workplace rather than by residence and will include migrant/temporarily resident workers.

Where work in a local area (for example, on an assembly site) is carried out by people who have moved temporarily from elsewhere in the Philippines or overseas and live in temporary accommodation while working on site, their daily expenditures on accommodation, food and drink, leisure and the like create employment impacts locally and within the Philippines more widely. These impacts have been considered in the indirect impacts because these payments are likely to be covered through subsistence expenses rather than personal expenditure.

The GVA to gross earnings ratio for a business can be relatively high where it is charging for use of expensive plant, equipment, boats, and so on. If a specialist vessel, for example, has been built in the Philippines for offshore renewables work, the prior employment and earnings impacts from this could be additional to what it has been possible to capture in the analysis carried out for this report.

In this report, GVA and earnings impacts have not been discounted prior to aggregation.

Definitions and assumptions

The economic analysis was structured around theoretical projects. To simplify the analysis, we assumed that these are floating projects. There are likely to be subtle differences in the economic impacts from fixed projects, but these are unlikely to be significant given the uncertainties over the future supply chain in the Philippines.

For each of the theoretical projects, we made judgments of local content for each of the supply chain categories defined in Section 11. Project costs in 2028, 2033, and 2038 were taken from the LCOE modelling described in Section 10. To simplify this analysis, we assumed that there is no real-term increase in salaries and that changes in cost for the projects between 2028 and 2038 are due to changes to technology and industry learning. As a result, the analysis is likely to underestimate the GVA.

To model economic impacts from 2022 to 2040, we interpolated costs and local content between 2028 and 2038. For impacts before 2028, we assumed that there were no changes per MW from the 2028 figures and for impacts in 2039 and 2040 and no changes per MW from the 2038 figures.

Our analysis has assumed that work undertaken in the Philippines has twice the human resource intensity of European companies because lower wage costs reduce the business case for investment in automation.

13. GENDER ASPECTS

13.1 PURPOSE

In this work package, we present the status of gender equality in the Philippines and look at existing legislation and policies that will affect the creation of a diverse OSW workforce.

We present the case for taking a proactive approach to ensure a gender equal OSW industry evolves in the Philippines. We also look at some learnings around workforce diversity from the development of OSW in other countries to highlight ways of eliminating or lowering common barriers to achieving gender equality.

13.2 METHOD

The findings of this section are the result of research to understand the existing position of men and women in the Philippines workforce and education system and of the legal and regulatory environment around gender discrimination and diversity targets in the country.

Desk research and stakeholder engagement looked at how other countries have approached gender equality issues in the wind industry. This enabled the creation of policy recommendations that can help remove barriers to the equal participation of women in the Philippines' OSW industry.

13.3 RESULTS

For the long-term success of OSW, and to establish it as a leading global industry, it is important to address the gender, diversity, and inclusion challenges of our time. Research shows that 32 percent of renewable energy jobs are held by women compared to 22 percent in oil and gas.[23] Recent analysis focusing specifically on OSW has, however, revealed that the global average for women in OSW is 21 percent with Taiwan, China, topping the diversity charts at just 26 percent. Poor diversity can be seen as a structural threat to the health of the OSW industry as multiple studies have shown that a diverse workforce is beneficial to the growth, innovation, resilience, and sustainability of all industries. A diverse workforce also gives the biggest opportunity to attract the best talent into the industry workforce.[25]

The pursuit of gender equality is also mandated by existing legislation and soft law treaties to which the Philippines is a signatory. For example, the 2015 Paris Agreement states that nations should "respect, promote and consider" their obligations toward gender equality and the empowerment of women as they reduce their emissions. The Philippines is also committed to the UN's 17 Sustainable Development Goals (SDGs). Gender aspects play an important role in SDG 5 (Gender equality) and SDG 8 (Decent work and economic growth). The development of the OSW industry in the Philippines will also benefit women as consumers by providing affordable, sustainable energy to the grid, which will help meet SDG 7 (Affordable and clean energy).

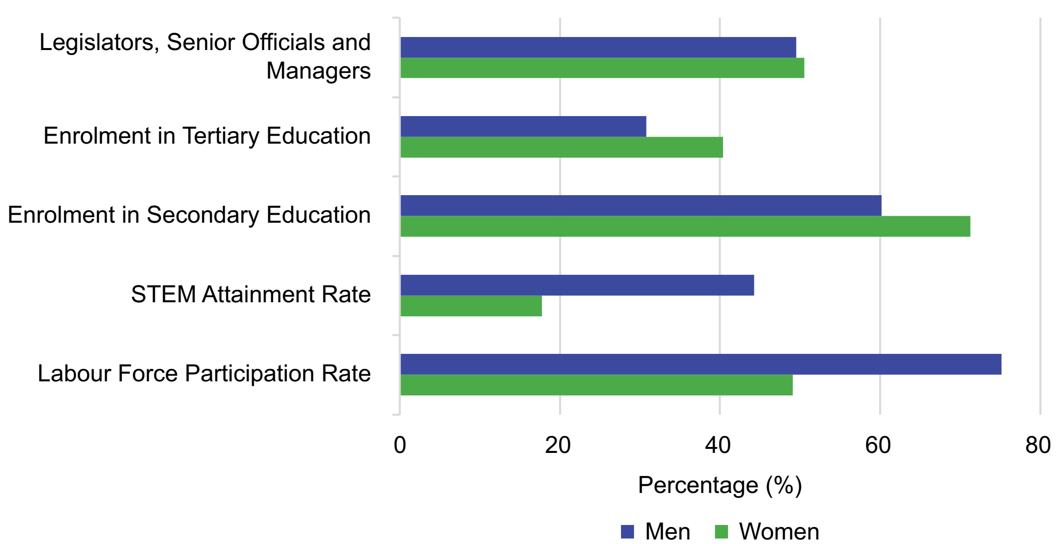
The Philippines has passed advanced legislation that protects and promotes women's rights. Most relevant to the development of an OSW industry in the country is *Republic Act 9710 (the Magna Carta of Women)*,[26] which was introduced in 2009 and prohibits discrimination against women by public and private entities as well as individuals. Government agencies to individuals that violate the Magna Carta legislation are liable for damages. The law also makes specific provisions for the equal access of women in education scholarships and training and establishes incentives and awards for companies and government agencies that make outstanding contributions toward implementing the act.

The *Magna Carta of Women* mandates that the government is responsible for policy formulation contributing toward gender equality and that it must generate and maintain gender statistics and sex disaggregated databases to ensure targeted interventions and measure progress toward equality goals. State agencies have gender and development (GAD) budgets to implement programs under *the Magna Carta of Women*, which mandates that the government prioritizes the allocation of all available resources to fulfill the obligations of the law.

There is already a strong network of women's rights organizations in the Philippines that possess a wealth of knowledge on working inside the unique sociocultural context of the country to address problems of structural gender inequality. Global Wind Energy Council (GWEC) and Global Women's Network for the Energy Transition (GWNET) also operate the *Women in Wind Global Leadership Program* to accelerate the careers of women in the sector.

According to the World Economic Forum's Global Gender Gap Report 2021,[8] the Philippines is ranked 17 overall (out of 156 listed) and the best performing country in East Asia when it comes to closing the gender gap around key metrics. The Philippines has largely closed gaps around educational attainment, health, and the number of women relative to men in senior or technical roles, as shown in Figure 13.1 and Figure 13.2.

FIGURE 13.1 KEY METRICS FOR MEN AND WOMEN IN THE PHILIPPINES WORKFORCE

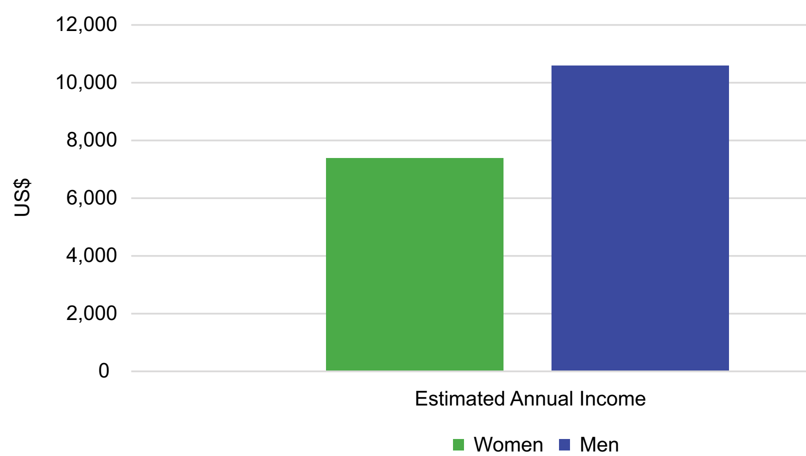


Source: BVG Associates.
Note: STEM=Science, technology, engineering, and mathematics

To give context, the next best performing East Asian country, Lao PDR, is ranked 36 overall. There, the labor force participation rate is 80.5 percent for women compared to 82.3 percent for men. Some 15.5 percent of women in Lao PDR are enrolled in tertiary education compared to 14.4 percent for men and significant gaps remain in regard to science, technology, engineering, and mathematics (STEM) attainment rates which stand at 12.3 percent for women and 32.4 percent for men.

The report also highlights that the Philippines has a significant gender pay gap across the economy, with men earning on average 43 percent more than women, as shown in Figure 13.2. This exists despite the 2007 Fair Pay Act[27] mandating equal pay for equivalent jobs. Therefore, it is suggested that women should be incentivized and supported to enter the job market to narrow the pay gap. Figure 13.1 shows that women also have a much lower attainment rate in STEM subjects, which are relevant to accessing many high paid jobs in society and within OSW.

FIGURE 13.2 THE GENDER PAY GAP IN THE PHILIPPINES



Source: BVG Associates.

Experience from the development of OSW in Northern Europe suggests that strong equality laws alone are not enough to ensure there is no such gap between the number of men and women in the wind energy workforce and the types of roles they occupy.

For example, GWEC's Women in Wind Program and the International Renewable Energy Agency (IRENA) have found that women make up 21 percent of the global wind energy workforce and that 65 percent of all women working in the sector perceive gender-related barriers.[28] Just 8 percent of senior management positions in wind energy are taken up by women, who generally occupy roles in administration and non-STEM occupations within the sector.

Early experience from the UK shows how OSW can suffer from even more acute gender imbalances, and a gender diverse industry will not emerge by itself so long as only external policies are in place. The UK installed its first OSW project in 2000 and by 2018 had 7.5 GW of installed OSW capacity with 7,200 people directly employed in the sector. Women, however, made up just 16 percent of that workforce, despite the UK having passed robust equality legislation. This shows that it is important to put schemes in place as the industry is established to challenge the social or cultural factors that create inequality.

Industry and the government have moved to address this gender disparity as part of the UK *Offshore Wind Sector Deal*[29] signed in 2018, which seeks to address a broad range of gender issues affecting the sector. An aspirational target of ensuring women make up at least 40 percent of the OSW workforce by 2030 has been set. Meeting this target will be challenging, but educational institutions and OSW industry programs are working to eliminate the significant barriers that exist to prevent women from either joining or staying in the OSW. These include the following:

- Sociocultural norms that drive men and women to pursue different educational and employment opportunities
- Hiring practices that unconsciously or inadvertently discriminate against women
- A lack of gender targets within the industry
- Workplace conditions and policies that discourage women
- A lack of networking spaces and opportunities for women in a male-dominated sector
- A lack of awareness about these barriers in a male-dominated sector.

Since the publication of the *Offshore Wind Sector Deal*, the UK has taken another major step to ensure progress toward its 40 percent target. This has been achieved in part by incorporating gender equality requirements in a scored 'supply chain plan' assessment which developers must pass as a prerequisite for participating in future power purchase auctions.

13.4 DISCUSSION

Anecdotal evidence and feedback during the development of the roadmap supports the fact that the Philippines has done well in closing the gender gap in many areas. The Philippines has legislated for equality, but activities outside of this work need to be carried out to challenge the social norms that guide different male and female perspectives around education pathways and career choices. Acknowledging the gender equality challenges seen in the UK, the industry needs to take an active role in changing the culture around women pursuing STEM subjects and strive to ensure the OSW industry is an attractive place for women to work. This is an acute challenge for OSW. Women are underrepresented in maritime industries due to multiple factors including nonfamily-friendly working conditions and sexual harassment risk.[30] The OSW industry needs to consider ways to make offshore jobs more attractive to women, encouraging them into the sector and retaining them.

The Philippine Government has an ongoing 20-year GAD plan,[31] which runs to 2025. The GAD allocates a budget to each government agency for pursuing equality programs. It is important that the OSW industry and the DOE collaborate closely to make the most of this resource.

13.5 RECOMMENDATIONS

Based on the above analysis, the following are recommended:

- Industry involves developers and supply chain companies in gender equality working groups, supported by women's rights organizations in the Philippines, GWEC, and GWNET. This will help ensure women can play an active role in shaping the sector, thus making offshore jobs attractive.
- The government and industry together determine the key data that need to be collected to ensure progress to diversity targets is measured and make sure a framework is in place to collect it accurately. Existing sex aggregated data collected under the GAD should be used for human resource and planning as the industry grows.
- Industry ensures opportunities for women in OSW are well promoted to encourage women to pursue STEM subjects to secure rewarding careers in the sector.
- Industry uses gender decoders and gender-balanced language to ensure hiring practices are unbiased.
- Industry creates spaces and opportunities for women to network within the OSW sector to reduce harassment risk and prevent leadership roles from becoming male dominated.
- The government and industry encourage women to develop STEM interest aspirations and ensure apprenticeship schemes attract female talent.
- The government and industry look across sectors that have low gender imbalances in the Philippines to find any relevant learning.
- Industry focuses efforts on increasing gender diversity in job areas where women are typically poorly represented, for example, OSW turbine technicians.
- Industry publishes a best practice guide for stakeholders.
- The government considers introducing gender equality requirements into leasing and power purchase frameworks, for example, requiring project developers to demonstrate diversity good practice in recruitment and communicate the gender makeup of project teams and specifying such requirements on their key suppliers.

14. ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

14.1 PURPOSE

In this work package, we describe and rate the environmental and social considerations relevant to OSW in the Philippines.

14.2 METHOD

A review has been undertaken of the applicable national laws, policies, regulations, and environmental and social considerations associated with the development, installation, and operation of OSW, with a focus on offshore rather than onshore aspects. This included information provided by The Biodiversity Consultancy (refer to the Appendix).

Further detailed studies, surveys, and consultations will be required to be undertaken by the government, stakeholders, and project developers on environmental and social considerations. This will be required at both a countrywide marine spatial planning level and at a project-specific level. Future studies and surveys should include the consideration of cumulative impacts between projects.

We assessed conditions in general and in the potential OSW development zones shown in Figure 2.5. The locations of these zones are derived in Section 9. Section 14 is limited to discussing each consideration. The zones have been included in the maps in this section to show their location relative to specific environmental and social considerations.

The assessment presents the environmental and social considerations relevant to the development, installation, and operation of OSW projects. The rating shown in Table 14.1 has been used to show the potential impact of OSW on key receptors.

TABLE 14.1 RAG SCALE FOR ENVIRONMENTAL, SOCIAL, AND TECHNICAL CONSIDERATIONS

Scale values	Description
Red	OSW development has the potential to have significant impact or influence on the environmental or social consideration.
Amber	OSW development has the potential to have an impact or influence on the environmental or social consideration.
Green	OSW development is unlikely to have an impact or influence on the environmental or social consideration.

Note: RAG=Red-Amber-Green

These categories are defined based on a combination of our knowledge and professional judgment of considerations relevant to OSW in other markets, and through limited early engagement with some relevant stakeholders in the Philippines. Beyond this roadmap, further work is needed to provide a full view of environmental and social considerations.

The inputs from local stakeholders have been assessed for their relevance and incorporated to ensure that the preliminary assessment is in line with GIIP.

For each constraint, the following have been undertaken:

- Assessment of how the constraint is considered in laws and applied in practice in the Philippines
- Consideration of the potential impact of an OSW
- Determination of the extent to which the constraint is relevant to potential OSW development zones in the Philippines
- Discussion of options to address the constraint
- Categorization into two types of consideration, further used in Section 9:
  - Exclusions - areas of highest environmental or social sensitivity to be excluded from OSW assessment
  - Restrictions - high-risk areas requiring further evaluation for OSW site selection, ESIA and MSP.

An initial list of key stakeholders who have a concern for the environmental and social considerations in developing OSW are listed as follows:

Government Institutions/Agencies:

- Local, provincial, regional, and national government units and community leaders
- Biodiversity Management Bureau (DENR-BMB)
- Bureau of Fisheries and Aquatic Resources (BFAR)
- Cebu Port Authority
- Civil Aviation Authority of The Philippines (CAAP)
- Department of Energy (DOE)
- DENR, especially Environmental Management Bureau (EMB)
- Department of Interior and Local Government through its Philippine National Police – Maritime Group
- Department of National Defense (DND) through the Philippine Navy
- Department of Science and Technology through the Philippine Council for Aquatic and Marine Research and Development (PCAMRD)
- Department of Tourism (DOT)
- Department of Transportation through its Philippine Ports Authority (PPA), Maritime Industry Authority (MARINA), and the Philippine Coast Guard (PCG)
- Fisheries and Aquatic Resources Council

- National Economic and Development Authority (NEDA)
- National Commission on Indigenous Peoples (NCIP)
- National Grid Corporation of the Philippines (NGCP)
- National Mapping and Resources Information Authority (NAMRIA) of the DENR.

NGOs/Academes/Private Entities:

- Electric companies involved in OSW development
- Businesses and project developers with relevance or potential interest to OSW project in the Philippines
- Nongovernmental organizations (NGOs) with relevance or interest to OSW project in the Philippines, such as Biodiversity Conservation Society of the Philippines, Haribon Foundation, Marine Conservation Philippines, WWF Philippines, and so on.
- Philippines academic organizations with relevance or interest to OSW project in the Philippines such as De La Salle University Br. Alfred Shields FSC Ocean Research (SHORE) Center, University of Philippine Marine Mammal Research & Stranding Laboratory and University of Philippines Marine Science Institute (MSI).
- Communities and fisherfolk that may be affected.

See Section 22 for more details. For MSP activities we suggest that the majority of organizations listed would be 'Key consultees'. NAMRIA could be a 'Supporting agency' and the DENR could be the 'Lead coordinating agency'.

Consideration has also been given to the World Bank Environmental and Social Framework (ESF).[32] It consists of 10 core environmental and social standards (ESS) listed below. These core standards have been used to evaluate the environment and social risks posed by OSW development in the Philippines setting to refine the project outcome.

- ESS1: Assessment and Management of Environmental and Social Risks and Impacts
- ESS2: Labor and Working Conditions
- ESS3: Resource Efficiency and Pollution Prevention and Management
- ESS4: Community Health and Safety
- ESS5: Land Acquisition, Restrictions on Land Use, and Involuntary Resettlement
- ESS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources
- ESS7: Indigenous Peoples/Traditional Local Communities
- ESS8: Cultural Heritage
- ESS9: Financial Intermediaries
- ESS10: Stakeholder Engagement and Information Disclosure.

14.3 RESULTS

The key environmental and social considerations are outlined in Table 14.2, then discussed below. Spatial data layers used in the analysis are listed in Table 9.1.

TABLE 14.2 SUMMARY OF ENVIRONMENTAL, SOCIAL, AND TECHNICAL CONSIDERATIONS

Consideration	Category	Rating	Definition and potential OSW impact
A. Protected Areas and Key Biodiversity Areas (KBAs)	Environmental	R	Environmentally designated sites of regional, national, and international significance such as mangrove reserves, marine parks, and sanctuaries which are considered as high-risk areas. This includes identified freshwater and/or marine KBAs. OSW development during pre-construction and construction stages can cause displacement and habitat changes and pose a threat to marine species and surrounding biodiversity due to noise and vibration levels, and reduced water quality during construction.
B. Natural Habitats	Environmental	R	Coastal habitats such as coral reefs, seagrass beds, and mangrove forests. Construction in coastal areas and marine ecosystems can lead to biodiversity disturbance and possibility of local increased erosion caused by scour around new structures and water pollution during construction. Wastes anticipated for the project include domestic wastewater, solid wastes (hazardous and non-hazardous), oil and lubricants during construction. Indirect effects include interruption or changes to natural coastal processes such as tidal flows and sediment movement.
C. Sensitive marine species	Environmental	R	Includes dolphins, dugongs, sharks, rays, turtles, and other marine species sensitive to survey, construction, and operational activities. Includes various endangered species. Noise, acoustic vibration, and light produced during OSW construction can impact sensitive marine species causing changes in feeding and breeding patterns through habitat disruption. Increased sediment loading during construction and operation could cause smothering of habitats and species. Operational noise sources include mechanical (acoustic emission) and aerodynamic (noise created by the wind turbine blades interacting with the wind).
D. Bats and birds	Environmental	R	Habitats for resident and migratory bird species, particularly intertidal feeding grounds and high-tide roost sites which support populations of threatened species. OSW poses risk of injury or death from turbine collision, habitat displacement, disruption of feeding grounds, and changes in breeding patterns.
E. Artisanal and commercial fishing grounds	Social	R	Comprises commercial fishing areas, and small-scale fisheries for individual households or communities. In many countries, larger fishing vessels are not permitted to enter OSW farms, driving changes to fishing areas and practices, though changes in risk perceptions are in some cases softening such restrictions.

Consideration	Category	Rating	Definition and potential OSW impact
F. Aquaculture	Social	A	Areas for coastal aquaculture and mariculture of fish, shellfish, and seaweed in the country. OSW construction such as piling may cause noise/vibration impacts to the marine environment. Civil works increase the potential for water pollution that could result in potential economic displacement through reduced yields.
G. Landscape and seascape	Social	A	Any significant viewpoints (landscape, seascape, or visually significant landforms/structures) that will be affected by the visual impact of wind turbines and associated facilities, such as transmission lines and substations. Impacts can relate to the presence of infrastructure but also flicker or shadow effects changing as turbine rotors rotate.
H. Historical and cultural areas	Social	R	Shipwrecks and heritage sites that have significance to local culture or local setting. OSW construction can pose risks to potential offshore artifacts, that may have cultural or tourist value. Visual considerations are also relevant.
I. Tourism areas	Social	A	Tourism areas consist of beaches, hotels, natural areas, cultural/heritage buildings, and locations for water activities such as diving, surfing, recreational fishing, boating, sailing, and cruise ships. Construction activities can cause disruption. Visual considerations are also relevant. Early OSW projects can create new local tourism opportunities.
J. Ports and shipping routes*	Technical	R	Ports and shipping routes for a range of vessel sizes. Construction activities can cause temporary disruption, and larger vessels are not permitted to enter OSW farms, potentially driving changes to navigation routes. The presence of structures at sea are a collision risk. Road traffic due to associated onshore works (grid connection and transmission and port upgrades) can impact locally.
K. Military exercise areas*	Technical	G	This comprises military bases, firing ranges, exclusion zones (including due to radar), and military no-fly zones. Potential impacts are as directly above, plus OSW projects can affect radar and defense systems due to the presence of large, moving structures at sea (as rotors turn).
L. Aviation*	Technical	A	This comprises local and international airports, flight paths, and related radar systems. Potential impacts are risk of collision plus OSW projects can affect radar, as above.

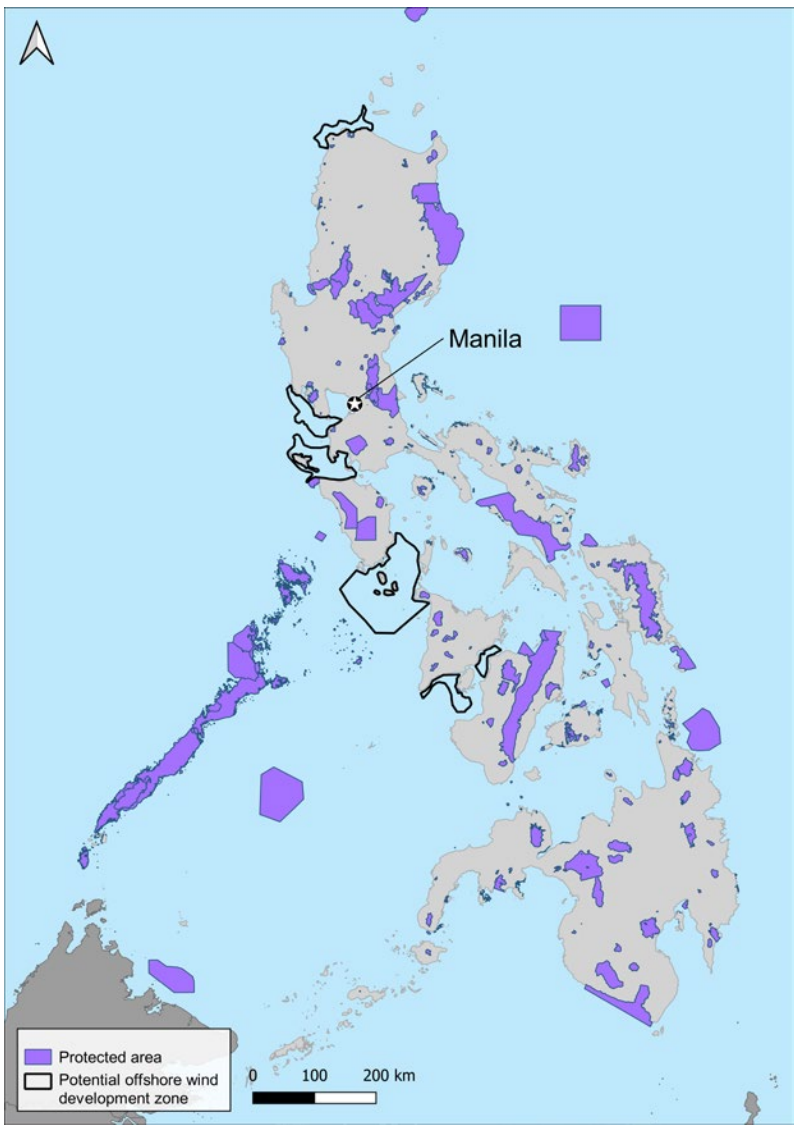
Note: *Are technical considerations and are not defined as social issues by WBG E&S standards.

A. Protected Areas and Key Biodiversity Areas

Protected Areas

Protected areas include both local and national protected areas in different state jurisdictions including strict nature reserves, natural parks and monuments, wildlife sanctuaries, protected landscapes and seascapes, and natural biotic areas. These areas, shown in Figure 14.1, are included in the NIPAS Act of 1992 and the Expanded National Integrated Protected Area System (ENIPAS) Act of 2018.[33,34] NIPAS and ENIPAS are both complemented by Wildlife Resources Conservation and Protection No. 9147,[35] which further identified critical habitats, being areas with endangered species that fall outside of the protected areas under NIPAS/ENIPAS.

FIGURE 14.1 PROTECTED AREAS IN THE PHILIPPINES



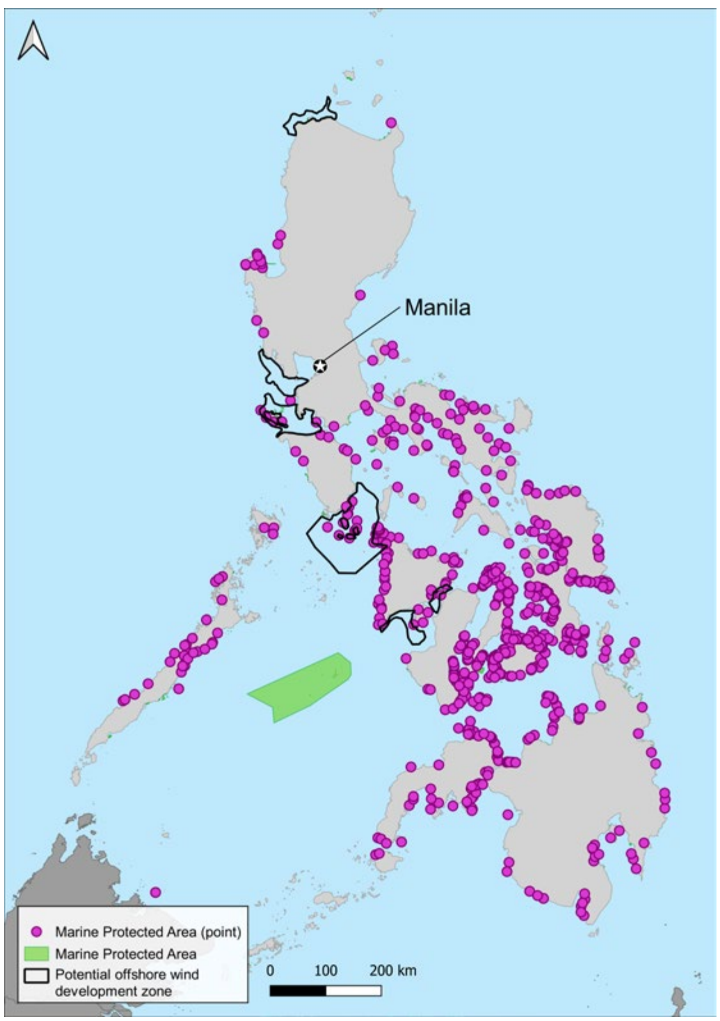
Source: see Table 9.1.

Coastal and Marine Protected Areas

Marine protected areas (MPAs) under NIPAS/ENIPAS include marine sanctuaries, marine reserves, marine parks, and protected landscapes and seascapes where protection might include marine resources. MPAs are established legally to protect marine habitats. Currently, ENIPAS covers 244 protected areas, 72 of which are classified as MPAs covering around 1.40 percent of the total sea area of the country. MPAs host globally threatened and restricted range species such as mollusks, sharks, rays, reef fishes, and marine turtles. Further, the Philippines covers more than 1,600 LMPAs under the Fisheries Code (Republic Act No. 8550)[36] and Local Government Code (Republic Act No. 7160).[37] LMPAs include all waters within a municipality not covered under the NIPAS Act. Figure 14.2 shows the locations of MPAs in the country.

MPAs are considered as exclusions while LMPAs are considered as restrictions due to insufficient spatial information on the biodiversity values distribution. Developing an OSW project in or near an MPA will require significant environmental and biodiversity consideration and implications on permitting and clearance requirements.

FIGURE 14.2 MARINE PROTECTED AREAS



Source: see Table 9.1.

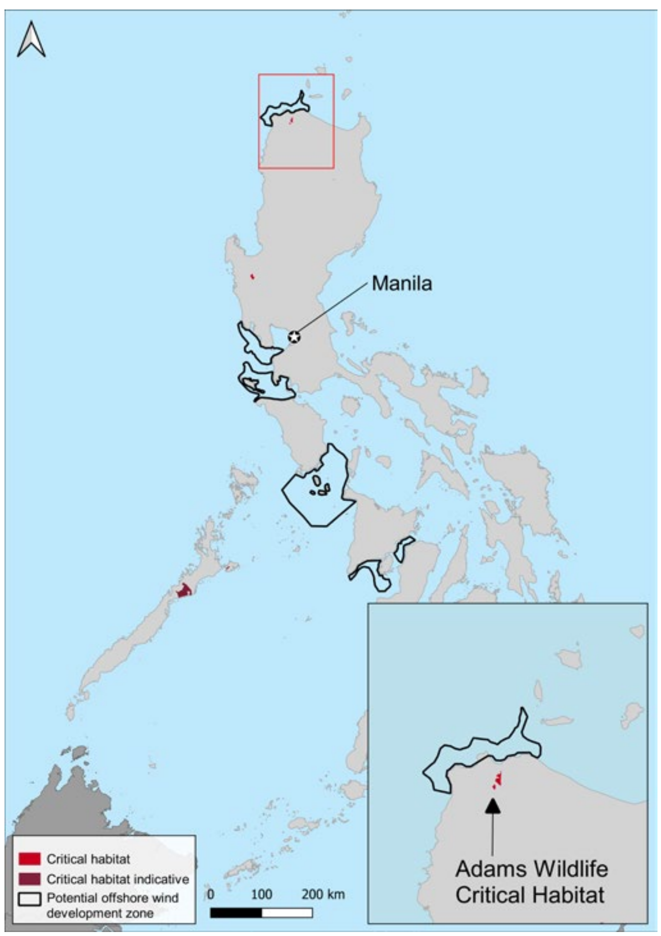
Critical Habitats

Critical habitats in the Philippines, as specified in DENR Administrative Order 2007-02, consist of five coastal and marine areas as shown in Figure 14.3 and listed below. These locations are considered as exclusions and must be avoided for the development of OSW:

- Cabusao Wetland Critical Habitat in Camarines Sur
- Carmen Critical Habitat in Agusan del Norte
- Adams Wildlife Critical Habitat in Ilocos Norte
- Magsaysay Critical Habitat for Hawksbill Turtles in Misamis Oriental
- Dumaran Critical Habitat in Dumaran, Palawan.

On inspection, it is found that only the Adams Wildlife Critical Habitat is located near one of the potential OSW development zones. This habitat represents the last frontier of the dipterocarp forest in the Ilocos Region. While it may be argued that this habitat would not be affected directly by an OSW development, consideration would need to be given to associated onshore infrastructure such as substations and transmission cables.

FIGURE 14.3 CRITICAL HABITATS



Source: see Table 9.1.
Note: Geographic positions are approximate

Key Biodiversity Areas

KBAs contribute to long-term survival of species and their habitats. Areas or sites are considered as KBAs if they meet one or more of the eleven criteria grouped into five major categories presented Table 14.3.

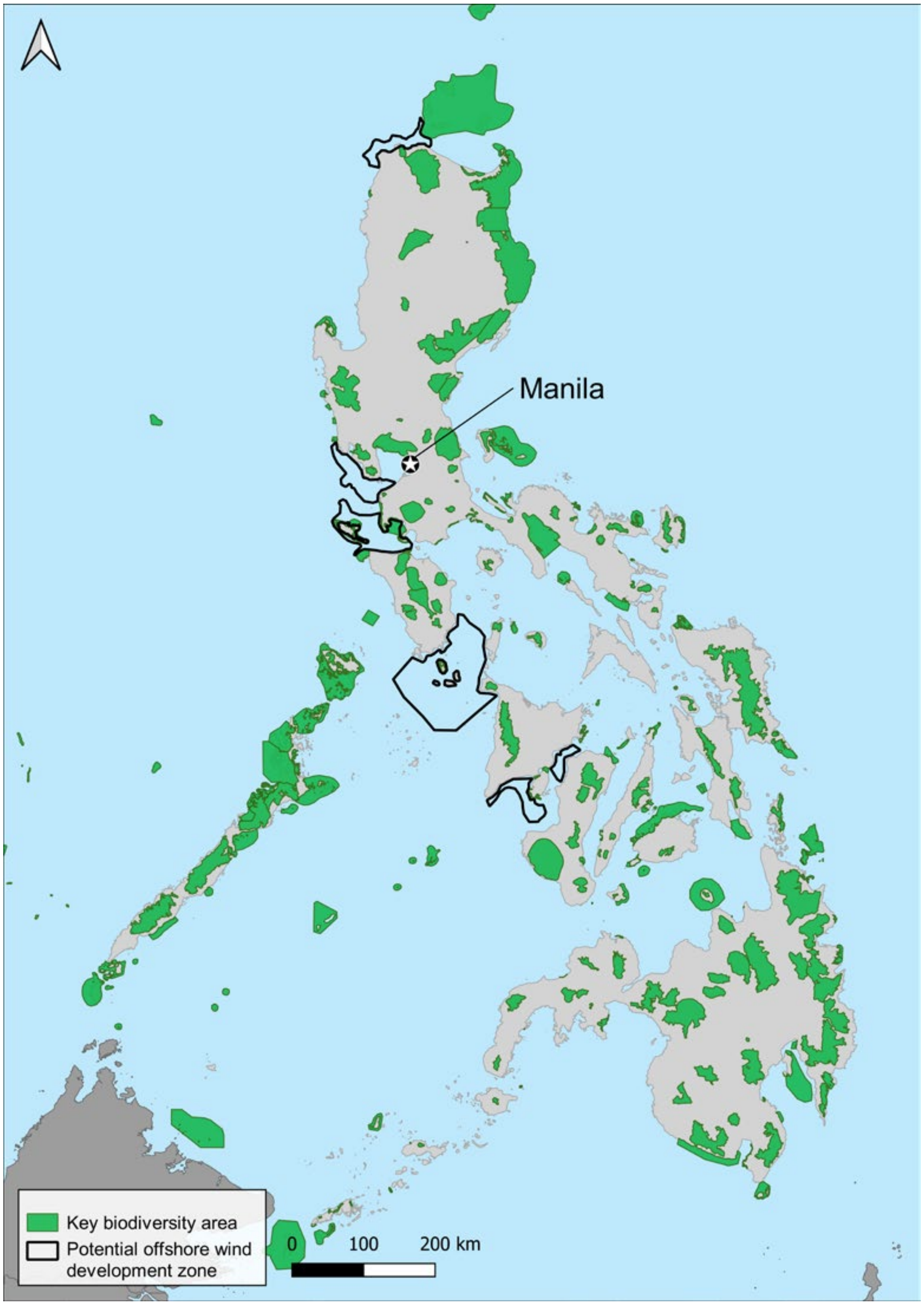
TABLE 14.3 CATEGORIES FOR KEY BIODIVERSITY AREAS

Categories	Description
Threatened biodiversity	Flora or fauna species in danger of extinction or perceived to becoming rare in the future if current numerical decline or habitat degradation trends continue.
Geographically restricted biodiversity	The area is a habitat for flora or fauna species found in only few places or sometimes nowhere else in the world.
Ecological integrity	The area that can maintain and support a community of organisms with species composition, diversity, and functional organization compared to other natural habitats within a region.
Biological processes	The area provides a platform for vital organism processes to live and shape its capacities for community and environment interaction.
Irreplaceability of the ecological system / fauna / flora within the area	The area is measured for its irreplaceability with regard to its environment and ecological processes as nesting ground for a specific fauna and flora species

KBAs in the Philippines have been categorized in two phases: 128 terrestrial and freshwater KBAs were designated in 2006, while a further 123 marine KBAs were designated in 2009. Most of these KBAs are recognized based on the 117 Important Bird Areas (IBAs) identified by BirdLife International and the Haribon Foundation, as well as 206 conservation priority areas (CPAs) defined in the Philippine Biodiversity Conservation Priority-Setting program. All Philippines KBAs with coastal and marine components specified in the World Database of KBAs are considered as exclusions.

Marine and terrestrial KBAs are shown in Figure 14.4, along with potential OSW development areas. Figure 14.4 shows that the five proposed development zones are near some of the marine and terrestrial KBAs. OSW development in KBAs in OSW development zones should not proceed. Also, for OSW development zones near KBAs, it is important to consider further evaluation and to determine appropriate mitigating measures.

FIGURE 14.4 KEY BIODIVERSITY AREAS IN THE PHILIPPINES



Source: see Table 9.1.

Other categories of KBAs that need to be considered for the development of OSW area are described in the subsections below.

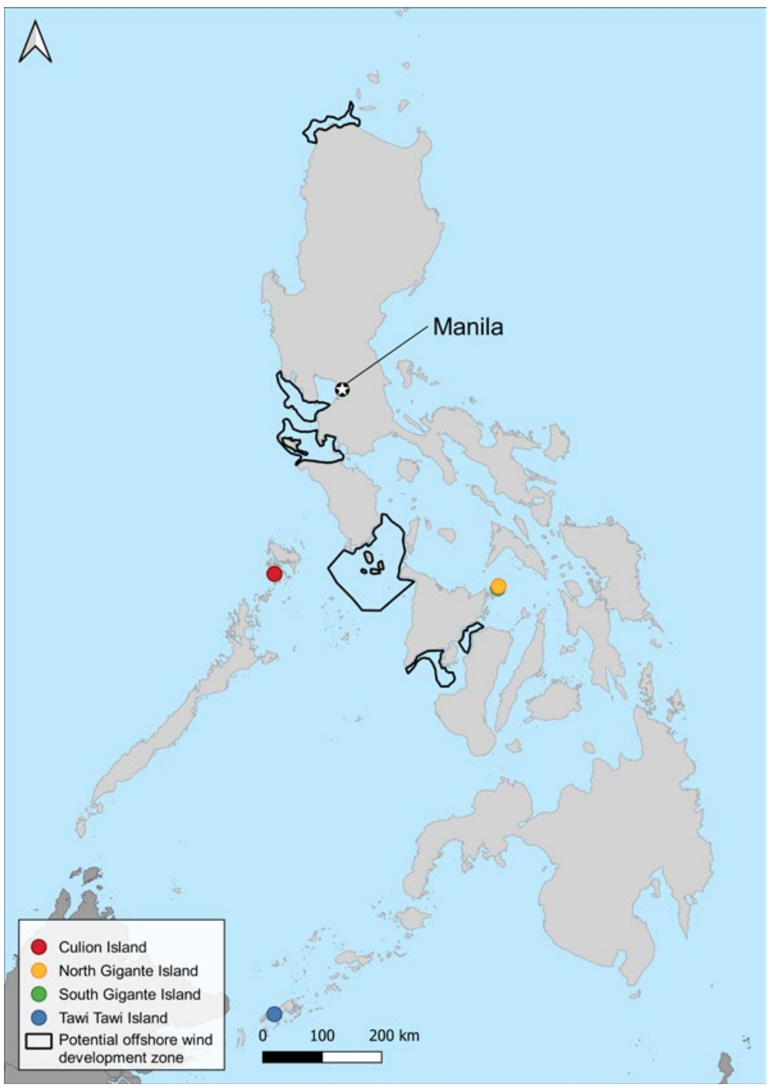
Alliance for Zero Extinction sites

Alliance for Zero Extinction (AZE) sites, as one of the KBAs, are known for conservation of the most significant areas for global biodiversity. A total of 835 globally identified AZE sites hold the remaining population of one or more critically endangered species.[38] There are twelve AZE locations in the country, as shown in Figure 14.5. Three of these have coastal and marine components:

- Culion Island
- South and North Gigantes Island
- Tawi-Tawi Island.

AZE locations are considered as exclusions.

FIGURE 14.5 AZE SITES IN THE PHILIPPINES



Source: see Table 9.1.

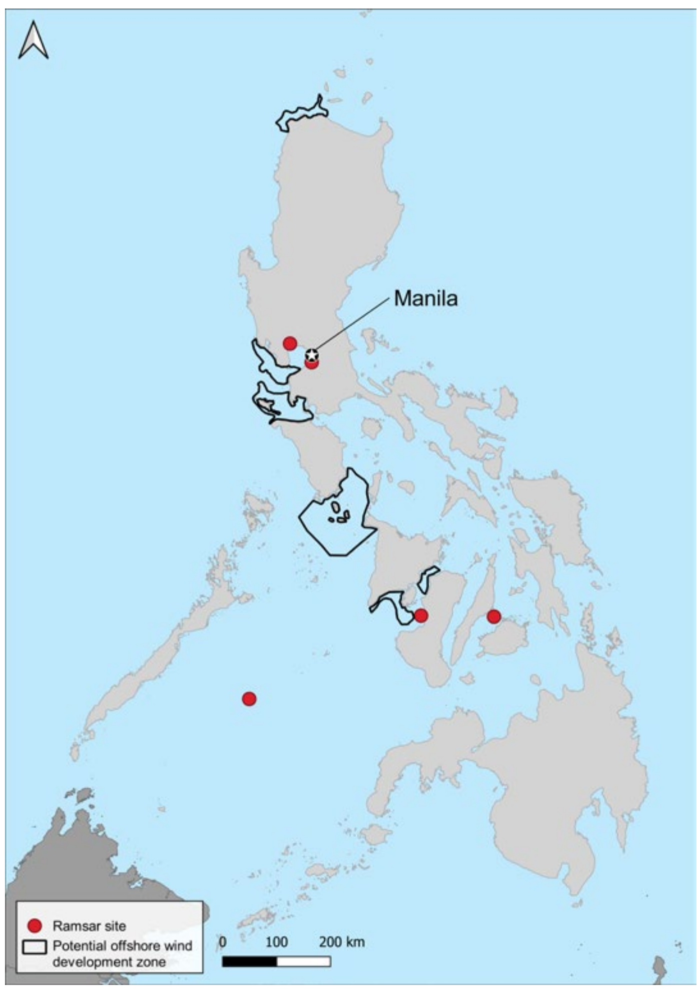
Ramsar Sites

Ramsar sites, as shown in Figure 14.6, are wetlands of international significance identified under the Ramsar Convention for containing representative, rare wetland types or for their importance in conserving biological diversity. Listed below are five Philippine Ramsar Sites with coastal and marine components:[39]

- Las Piñas-Parañaque Critical Habitat and Ecotourism Area
- Negros Occidental Wetlands Conservation Area
- Olango Island Wildlife Sanctuary
- Sasmuan Pampanga Coastal Wetlands
- Tubbataha Reefs Natural Park.

Some of these Ramsar sites are also identified as critical habitats and MPAs under NIPAS and the Wildlife Conservation Act, and overlap with UNESCO Natural World Heritage Sites, UNESCO-MAB Reserves, IBAs, and KBAs. All Ramsar sites are considered as exclusions.

FIGURE 14.6 RAMSAR SITES IN THE PHILIPPINES

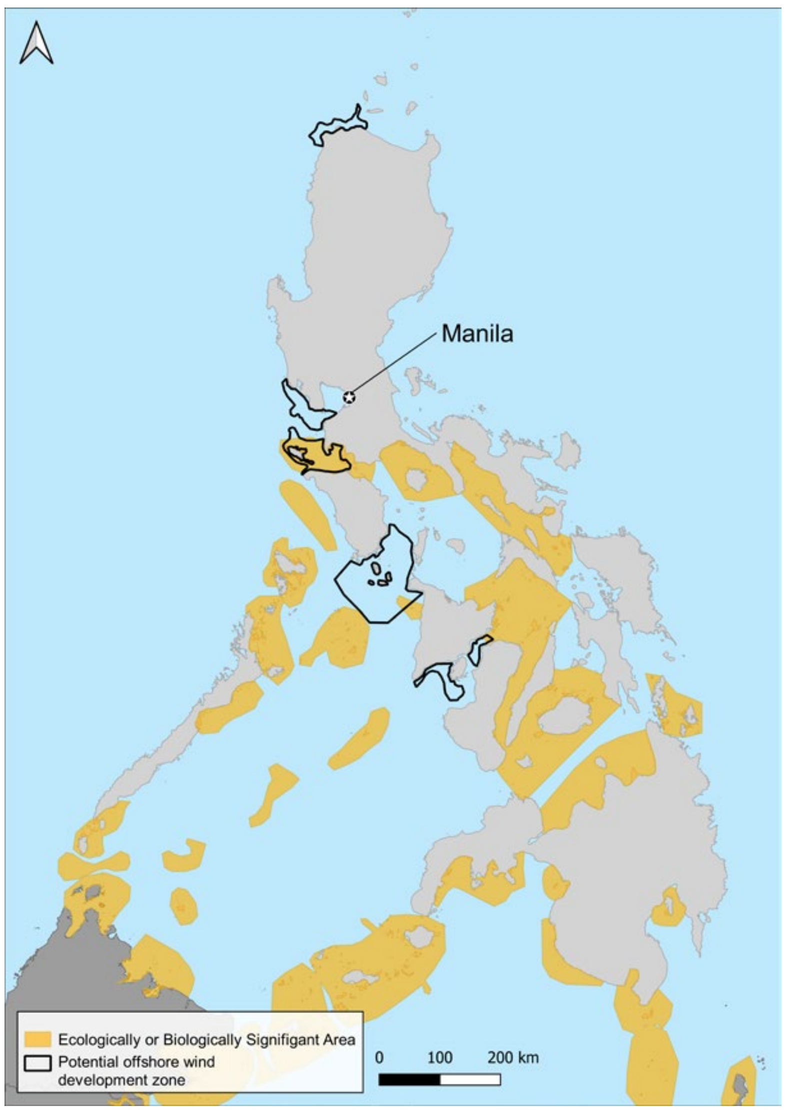


Source: see Table 9.1.

Ecologically or Biologically Significant Areas

Ecologically or Biologically Significant Areas (EBSAs) are discrete areas supporting the healthy functioning of oceans and the services that they provide. They include marine and terrestrial protected areas under Environmentally Critical Areas (ECAs), areas that are environmentally sensitive and listed under Presidential Proclamation No. 2146, series of 1981,[40] and areas considered as environmentally critical under Section 4 of PD 1586.[41] An examples of an EBSA in the Philippines is the Sulu-Sulawesi Marine Ecoregion (SSME) located at the apex of Coral Triangle Region and includes several marine areas. SSME is home to coral reefs, seagrass meadows, mangrove forests, fish, marine turtles, dolphins, whales, sharks, ray species, and marine flora and fauna. Seagrass beds in SSME provide vital feeding grounds for marine turtles and dugongs. The large coverage of EBSAs requires detailed spatial information and survey data to thoroughly evaluate the effects of OSW development near EBSAs, so they have not been treated as Restrictions or Exclusions at this stage. They are shown in Figure 14.7.

FIGURE 14.7 EBSAS IN THE PHILIPPINES



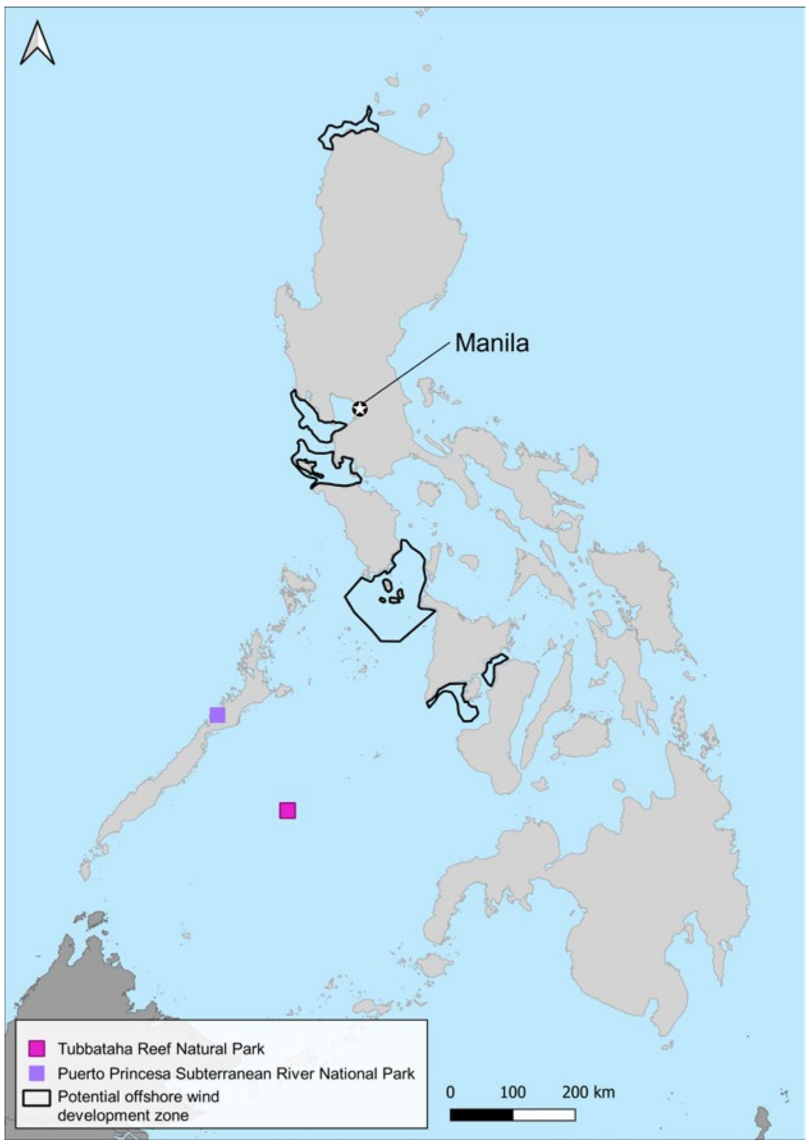
Source: see Table 9.1.

UNESCO World Heritage Natural Sites

UNESCO Heritage Natural Sites, as shown in Figure 14.8, are places of outstanding universal value to humanity. The Philippines has three natural heritage sites, two of which have marine and coastal aspects—the Puerto Princesa Subterranean River Natural Park and Tubbataha Reefs Natural Park.

The Puerto Princesa Subterranean River Natural Park in Palawan is home to tropical forests, mangroves, and a variety of endemic species. Meanwhile, the Tubbataha Reefs Natural Park in Sulu is a marine habitat for a range of whales, dolphins, sharks, marine turtles, and over 600 fish species including humphead wrasse. IFC Guidance Note 6 prohibits development in UNESCO World Heritage Sites. Thus, these areas are included as exclusions.

FIGURE 14.8 UNESCO WORLD HERITAGE SITES IN THE PHILIPPINES



Source: see Table 9.1.

UNESCO Man and the Biosphere Reserves

UNESCO MAB Reserves, as shown in Figure 14.9, are terrestrial, marine, and coastal ecosystems designated as learning areas for sustainable development. The Philippines has two biosphere reserves with coastal and marine features—Puerto Galera and Palawan.

The Puerto Galera Biosphere Reserve in Mindoro includes savanna and grassland, dipterocarp and mossy forests, coral reefs, and coastal ecosystems. The Palawan Biosphere Reserve covers the entire Palawan archipelago and has the largest mangrove cover in the country. The Palawan Biosphere Reserve is home to 105 threatened species in the Philippines, 379 corals, 13 seagrass, and 31 mangrove species. The two biosphere reserves are considered as exclusions.

FIGURE 14.9 UNESCO-MAB RESERVES IN THE PHILIPPINES

Source: see Table 9.1.

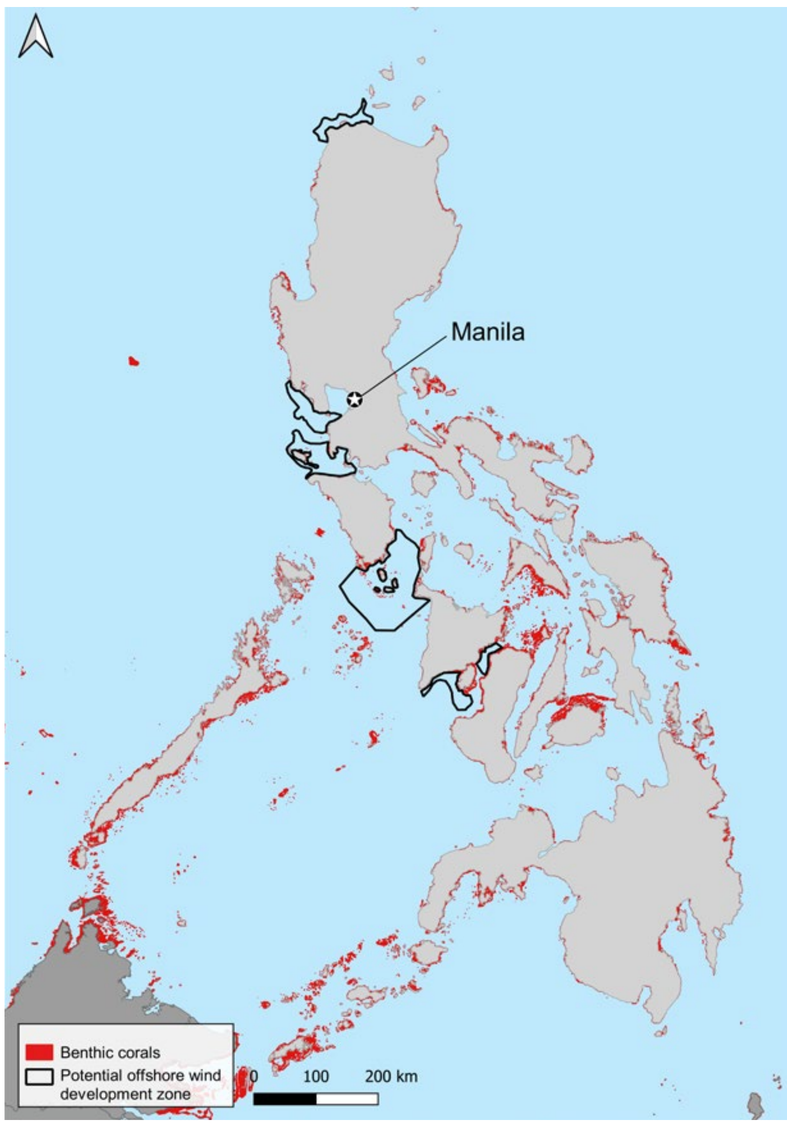
B. Natural Habitats

Natural habitats refer to several coastal and marine ecosystems that are both ecologically and economically important. Potential threatened natural habitats in the Philippines are coral reefs, seagrass beds, and mangrove forests.

Coral reefs

The Philippines is ranked third for the largest coral reef area in the world after Indonesia and Australia. The Philippines has 200 threatened and 12 endemic scleractinian (stony) corals. More than 40 million ha of coral reefs are estimated to be included within the KBAs, with 60 percent located in the West Philippines Sea around Kalayaan Group of Islands.[42] Coral reefs are not only habitat to five threatened marine turtle species and over 1,700 reef fish species, but also provide income to many Filipinos.[43] Coral reefs are shown in Figure 14.10. With this, coral reef natural habitats are considered as exclusions.

FIGURE 14.10 CORAL REEFS IN THE PHILIPPINES

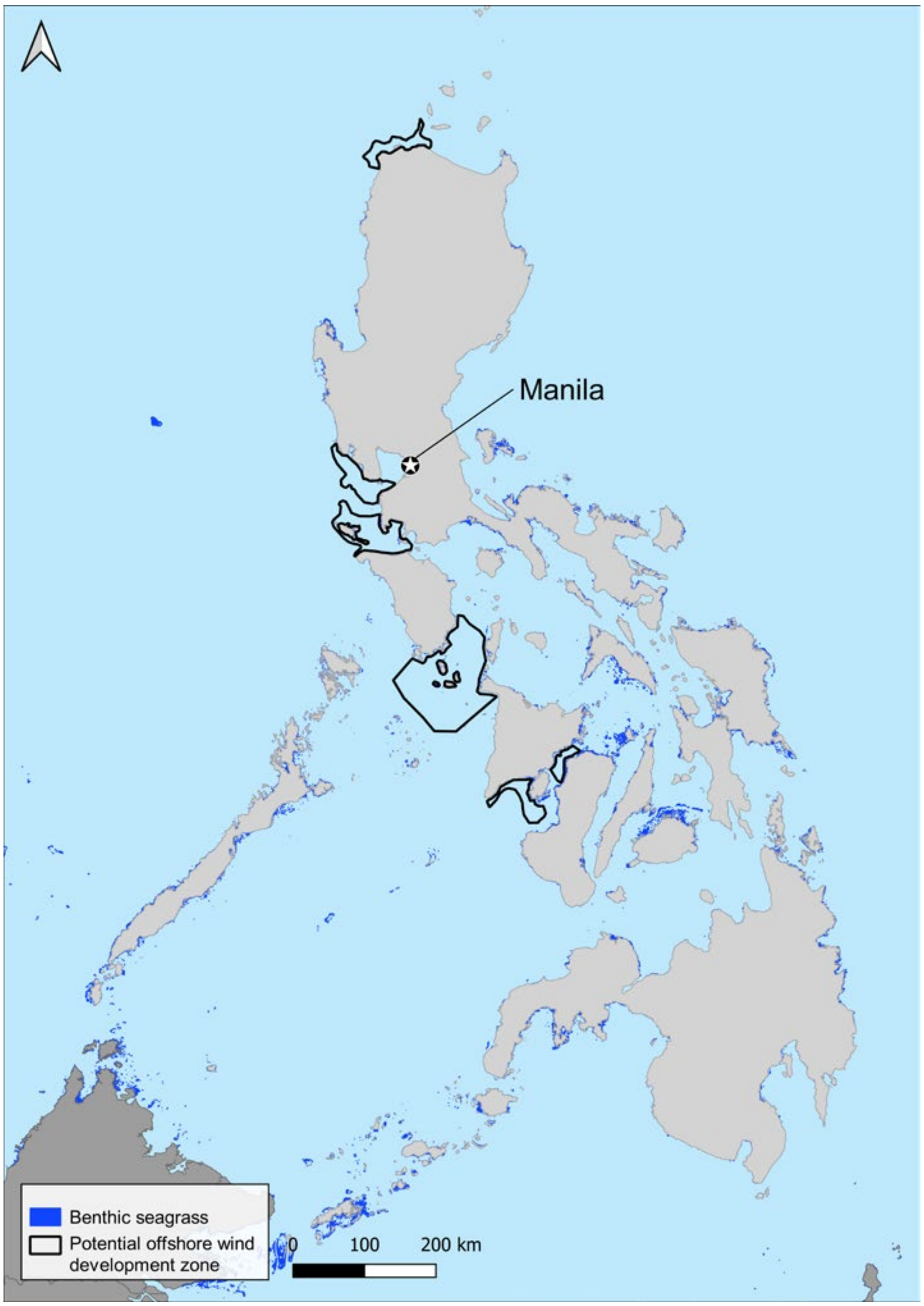


Source: see Table 9.1.

Seagrass beds

Seagrass beds provide important ecological and biological functions. They act as shoreline protection, support adjacent coral reefs and mangroves, and provide food and shelter to fish, invertebrates, marine turtles, and dugong. The Philippines has the highest seagrass diversity in Southeast Asia with 18 species found throughout the country, mainly in Bolinao Bay, Palawan, Cebu-Bohol-Siquijor area, Zamboanga, and Davao. Seagrass beds are considered as exclusions.

FIGURE 14.11 SEAGRASS AREAS IN THE PHILIPPINES

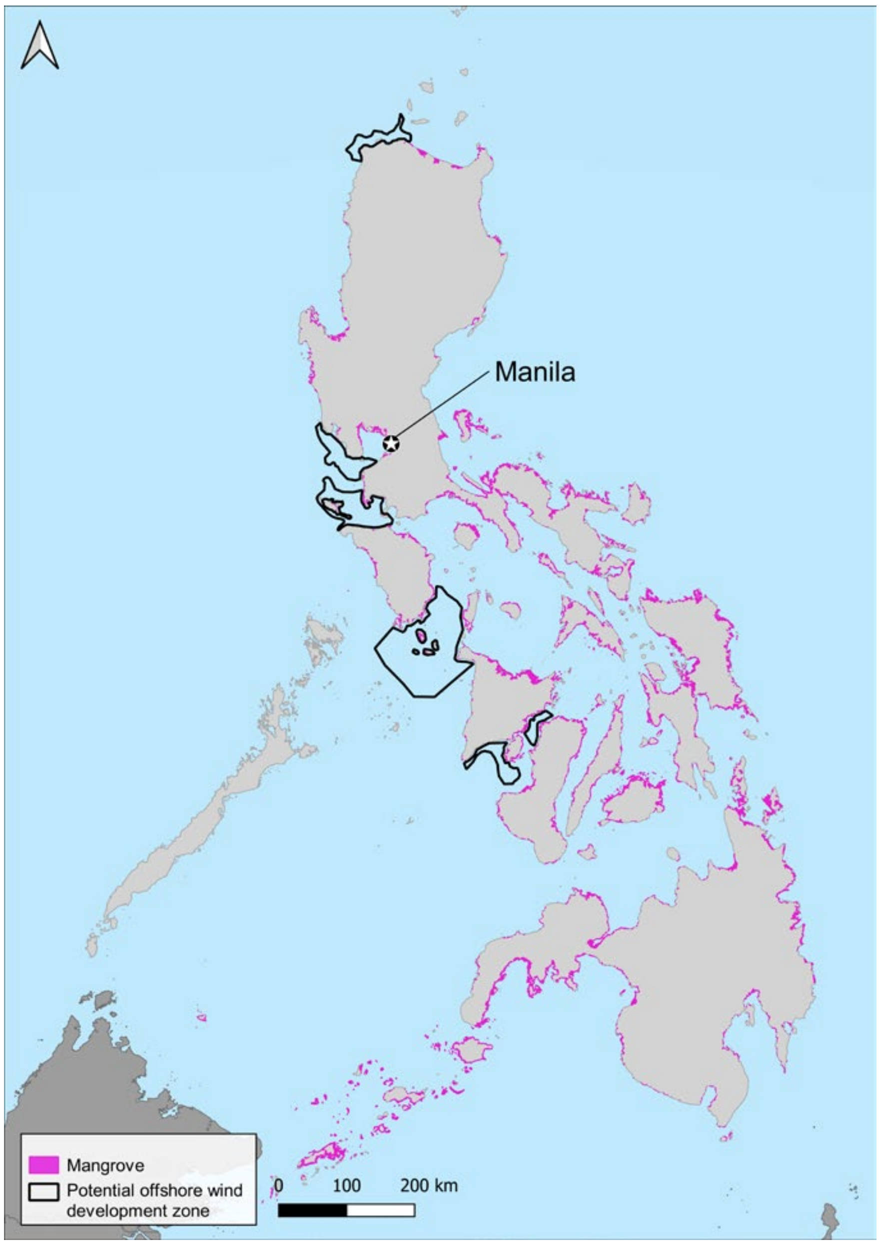


Source: see Table 9.1.

Mangrove forests

Mangrove forests, shown in Figure 14.12, are a significant part of the ecosystem in protecting shorelines, reducing the amount of carbon dioxide in the atmosphere and providing feeding areas for threatened marine species, dugong, turtles, cartilaginous fish, and cetaceans. Palawan province has the largest extent of mangroves in the country. Other provinces with major mangrove areas are Sulu, Quezon, Zamboanga Sibugay, Surigao del Norte, Tawi-Tawi, Samar, Zamboanga del Sur, Bohol, and Basilan provinces. Mangrove forests are considered as exclusions due to their significance to environment and marine conservation.

FIGURE 14.12 MANGROVE AREAS IN THE PHILIPPINES



Source: see Table 9.1.

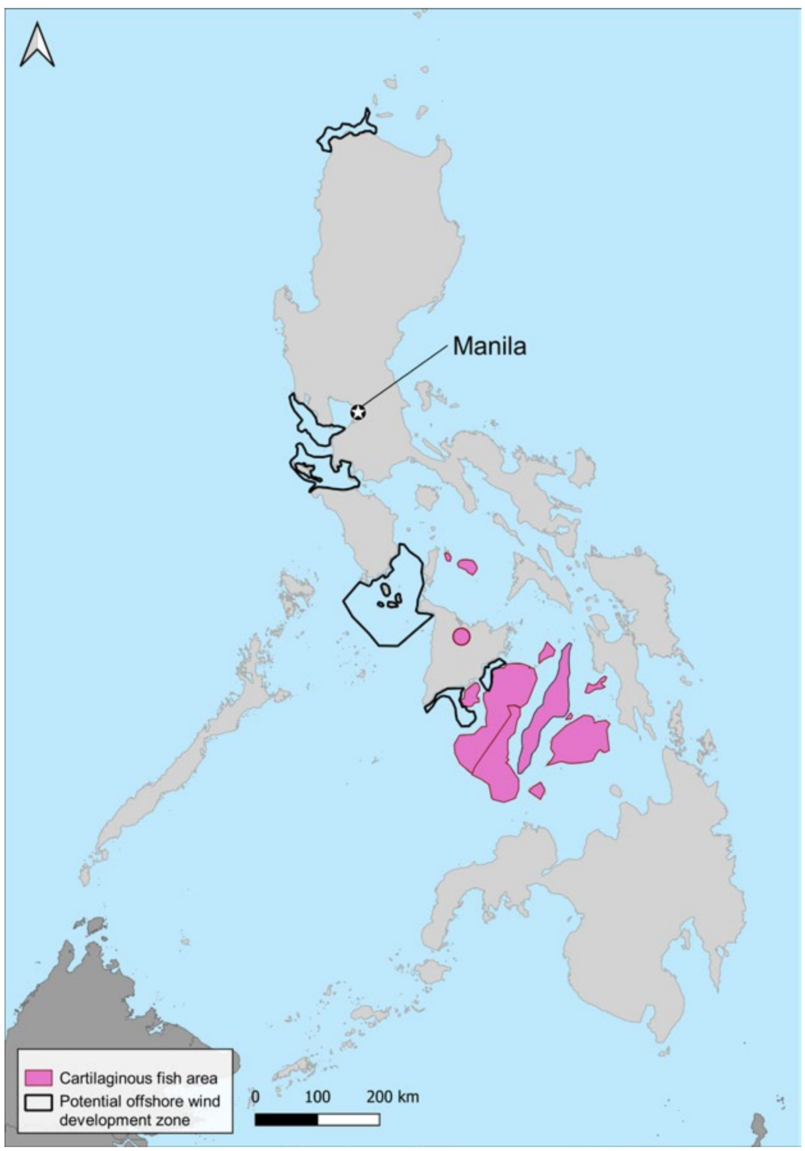
C. Sensitive Marine Species

Marine species are sensitive to survey, construction, and operational activities which may result in habitat disruption and displacement, pollution, vibration, exposure to electromagnetic fields, and underwater noise.

Cartilaginous Fish

The Philippines has more than 150 species of sharks, rays, and chimaeras, some of which have been identified as new and potentially endemic in the country.[44] Most sharks and ray species were recorded in Western Visayas, Central Visayas, and Ilocos regions. These areas are considered as restrictions requiring careful environmental impact assessment and MSP for OSW site selection to prevent habitat disturbance of cartilaginous fish.

FIGURE 14.13 CARTILAGINOUS FISH AREAS IN THE PHILIPPINES

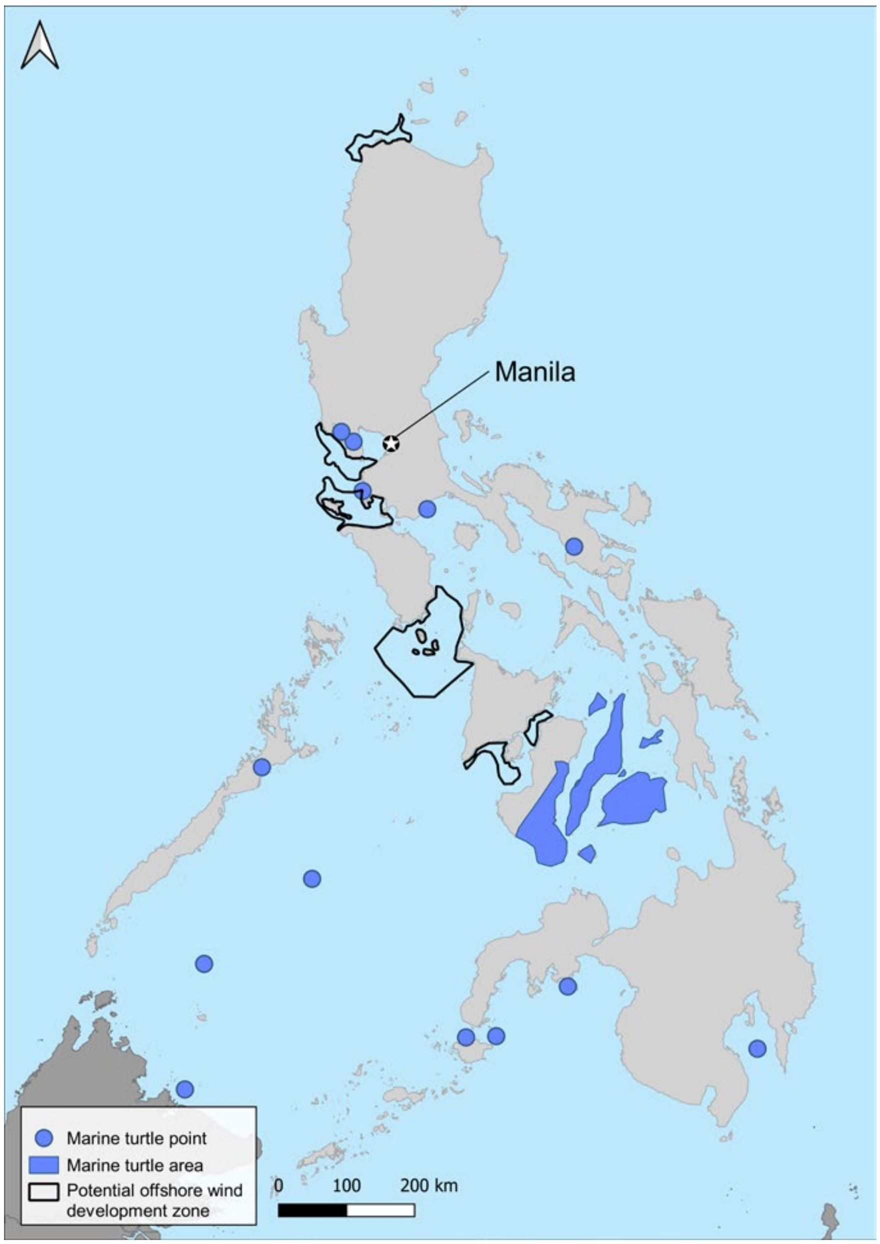


Source: see Table 9.1.

Marine Turtles

The Philippines has five of the seven marine turtle species in the world, all of which are considered threatened. These are the green turtle, the hawksbill turtle, the Olive Ridley turtle, the leatherback turtle, and the loggerhead turtle. The majority of the nesting places of these marine turtles are designated as Legally Protected Areas (LPAs). Turtle Island Wildlife Sanctuary and Tubbataha Reef National Marine Park are two of the most important LPAs for marine turtles. LPAs and Ramsar sites identified for foraging and nesting grounds of marine turtles are considered as exclusions.

FIGURE 14.14 MARINE TURTLE AREAS IN THE PHILIPPINES



Source: see Table 9.1.

Marine Mammals

The Philippines has 29 marine mammal species composed of 1 sirenian species (dugong) and 28 cetaceans, 5 of which are threatened species. Marine mammal species are recorded in all the main regions of the country. Sperm whales are found in all key seas of the Philippines. The Irrawaddy dolphin population is in Malampaya, Palawan while dugongs are mostly situated in the southern and western Mindanao coast, Guimaras Strait and Antique, Aurora, Quezon province, Tawi-Tawi and Sulu Archipelago. Also, there have been numerous sightings of blue whales in the Bohol Sea from 2010 to 2019[45].

IMMAs are distinct and important habitats for marine mammal species that have potential for conservation purposes. IMMAs are designated using the criteria below:

- Criterion A - Vulnerable species. These are areas important for survival of endangered species
- Criterion B - Distribution and Abundance including small and resident populations, and aggregations
- Criterion C - Key Life Cycle Activities which includes reproduction, feeding, and migration
- Criterion D - Special Attributes including diversity and distinctiveness.

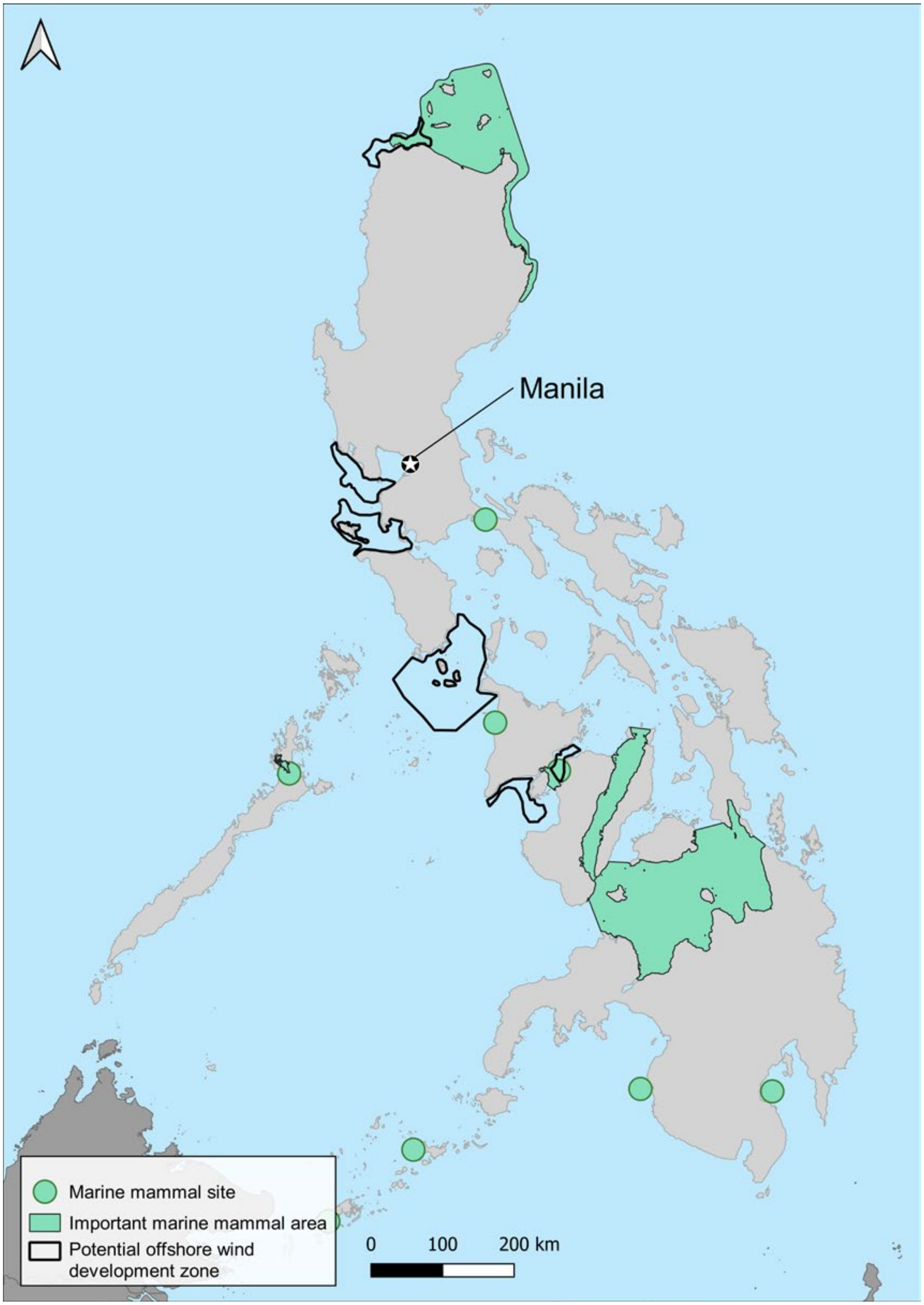
Listed below and shown in Figure 14.15 are the five IMMAs in the Philippines:

- Babuyan Marine Corridor
- Bohol Sea
- Iloilo and Guimaras Straits
- Malampaya Sound
- Tañon Strait.

Some of the IMMAs overlap with protected areas and KBAs. IMMAs are in general considered as exclusions, but the overlap of the Northwest Luzon potential OSW development zone, suitable only for floating OSW, with an IMMA is considered as a restriction. Floating OSW avoids seabed piling activities and is therefore likely to have a lower negative impact on marine mammals during construction, in comparison to piled, fixed foundation OSW. The deployment of floating OSW in this area may therefore be possible, but it is important to recognize that any development in this area would require careful assessment of the impact on whale activity in the area, following the precautionary principle, as part of ESIA. It would be prudent to start assessment of the potential interaction with whales in this area at an early stage, including commencing strategic, baseline surveys to better understand the marine mammal distribution and characteristics.

Likewise, dugongs are an important consideration in the Guimaras Strait. The IMMA in the Guimaras Strait has already been treated as an exclusion, limiting the potential OSW development zone. A marine mammal site is indicated in the strait. The size of any exclusion around this site has not been considered at this stage.

FIGURE 14.15 IMMAS IN THE PHILIPPINES



Source: see Table 9.1.

D. Bats and birds

Most of the bat species in the Philippines are found in caves, forests, and mountains, a considerable distance from offshore areas. Important bat species are however found in protected areas such as Sagay Marine Reserve, Negros Occidental which is home to giant fruit bats.[46]

While wind farms are known to affect bats, this is more commonly associated with onshore facilities and the impact from OSW is not expected to be significant. Despite this, during baseline studies, ecological surveys for bats should be carried out to ensure that bats that are known to frequent protected seascapes, such as those in Sagay, are properly considered and any impacts mitigated, if necessary.

The Philippines has several bird and biodiversity areas for seabird breeding and seasonal migration. A range of coastal areas host important populations of threatened birds. Coastal wetlands of the Philippines are part of the East Asian-Australasian Flyway (EAAF) monitored by the Asian Waterbird Census (AWC) at AWC sites in the country. The EAAF partnership identifies important sites within the flyway for long-term survival of migratory waterbirds. Philippines has three EAAF sites with coastal and marine components—Olango Island Wildlife Sanctuary, Tubbataha Reefs Natural Park, and Negros Occidental Coastal Wetlands Conservation Area.

The development of OSW projects can pose a significant risk to migratory birds through the risks of turbine collision, wind farm barrier effects, disturbance, habitat displacement, and disruption to feeding grounds. There are environmental laws which protect migratory birds and bats. These include the Wildlife Resources Conservation and Protection Act (Republic Act 9147).[47]

There are 117 Important Bird Areas in the country, covering a total area of approximately 2.7 million ha. The most relevant bird areas are those with marine components. Marine IBAs in the Philippines are Apo Reef Natural Park and Tubbataha Reef National Marine Park, both of which are designated KBAs. Apo Reef Natural Park has several habitats including small patches of mangroves, reefs, bird sanctuaries, and hawksbill and green turtle nesting grounds. Meanwhile Tubbataha Reef National Marine IBA in Central Sulu Sea serves as nesting grounds for seabirds and green turtle and hawksbill Turtle. This marine IBA supports a few of the remaining colonies of breeding seabirds in the region and is home to Oceanica White-tip Shark and threatened fish species like humphead wrasse and giant grouper.

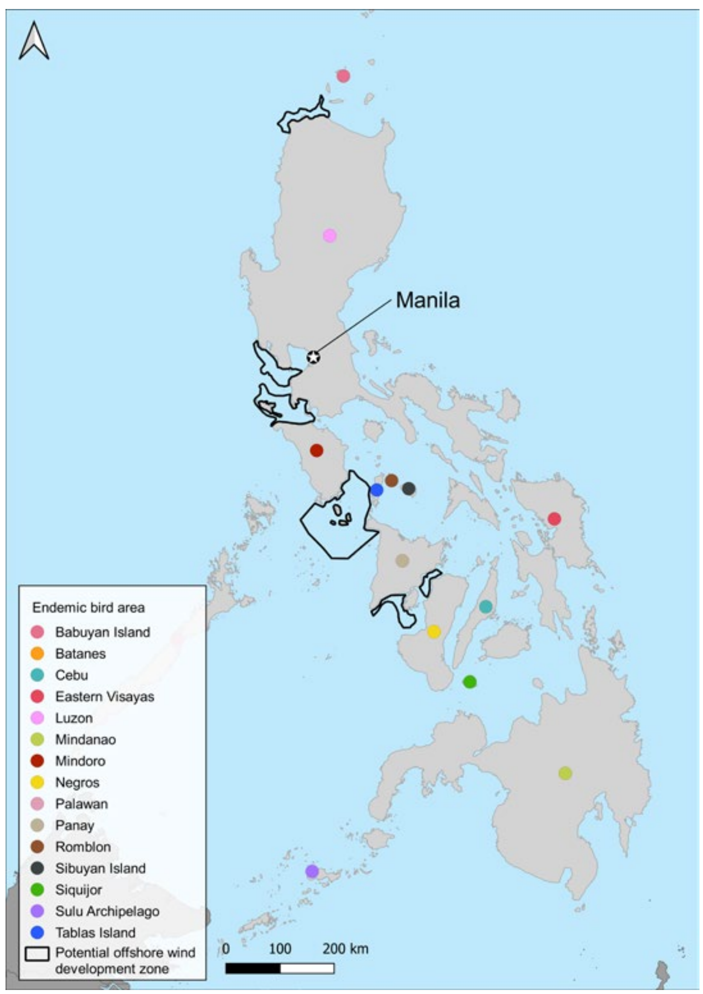
BirdLife identified EBAs as locations with overlapping breeding ranges of restricted-range species. The Philippines has 10 endemic bird areas which are recognized as Wetlands of International Importance specified below:

- Batanes and Babuyan Islands
- Cebu
- Luzon
- Mindanao and Eastern Visayas
- Mindoro
- Negros, and Panay
- Palawan

- Siquijor
- Sulu archipelago
- Tablas, Romblon, and Sibuyan.

Most EBAs cover large areas to be protected and have not been considered as either Exclusions or Restrictions in their own rights. Figure 14.16 shows the location of the EBAs. It is recommended that OSW development should be avoided in these areas to prevent significant mitigation measures and permitting delays. In cases that OSW development is not prevented in these locations, When OSW is not prevented in these locations, a critical habitat assessment is recommended to be prepared with detailed cumulative effects assessment focused on these impacts. Each season needs to be evaluated as the area may also be traversed by migratory birds. Assessment should identify possible turbine collisions, bird flight movements, and climatic factors to prevent potential hazards to bird species. Also, the assessment should identify species categorized by the International Union for Conservation of Nature (IUCN) Red List as Endangered (EN), Near Threatened (NT), and Least Concern (LC). No analysis of bird migration routes has been carried out at this stage as no existing spatial data was available, however this should be considered in future MSP activities.

FIGURE 14.16 ENDEMIC BIRD AREAS IN THE PHILIPPINES



Source: see Table 9.1.

E. Artisanal and commercial fishing grounds

Fishing in the Philippines is an important source of food, economic activity, and livelihoods. Artisanal fishing uses low capital, conventional or low-technology fishing methods, and relatively small fishing boats for individual or local consumption. The latest Philippines Fisheries Code, Republic Act No. 1065a, states that artisanal fisherfolk are allowed to access fishery resources inside the country's municipal waters or 15 kilometers from the coastline to protect the spawning areas of marine organisms.

Commercial fishing consists of medium- to large-scale fishing activities for commercial profit. All types of artisanal and commercial fishing practices from traditional techniques, pole and line fishing, gillnets, trawling, to purse seine fishing are likely to be constrained by the presence of OSW infrastructure sites.

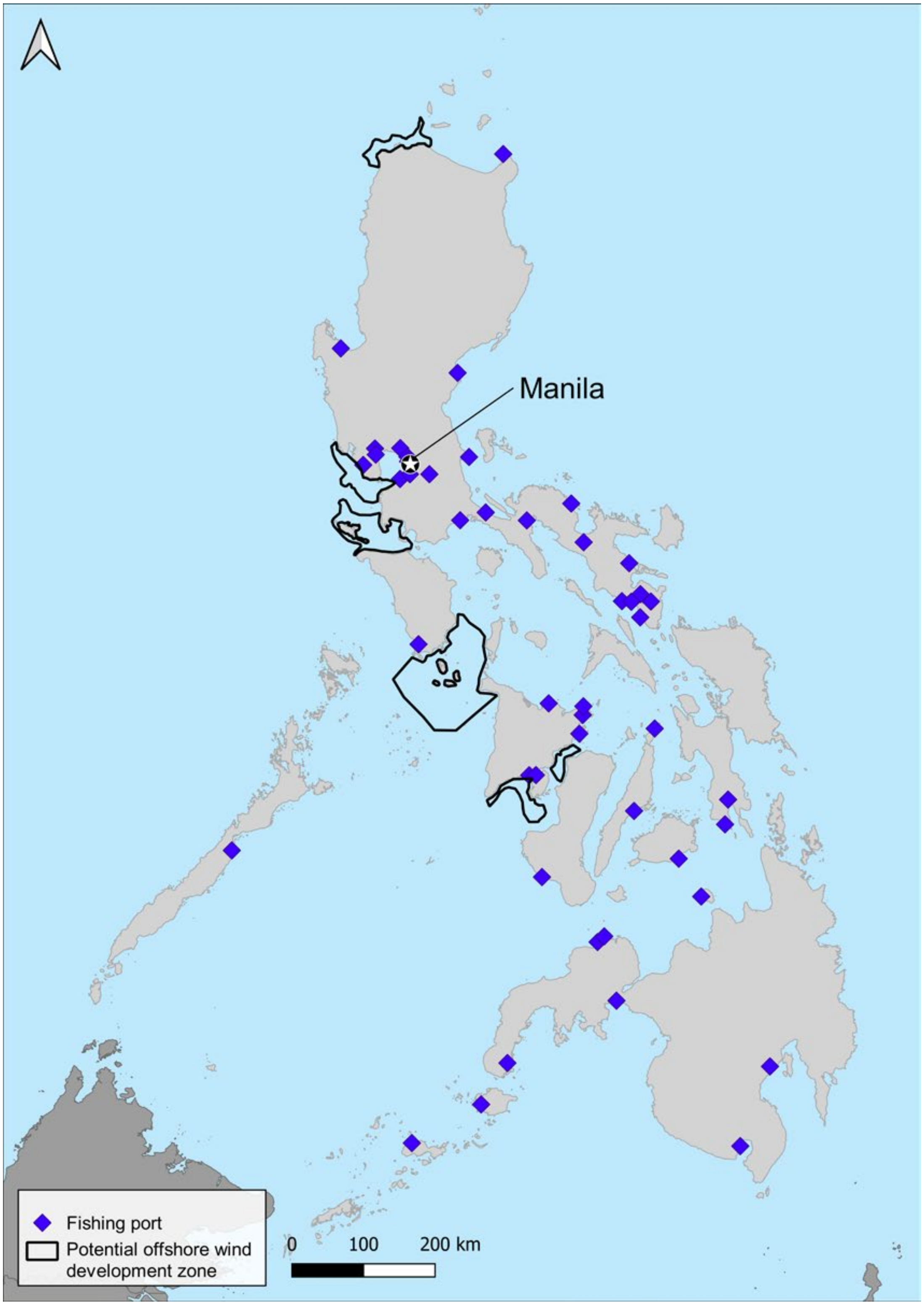
Changes to fishing practices, stocks, and the physical environment (including climate change) can lead to the location of important fishing grounds over time. The installation of foundations and cables can also temporarily increase suspended sediments in the water with negative impacts to both artisanal and commercial fisheries.

Options, beyond consultation with the fishing community, include:

- Site selection to avoid interference with the most important commercial fishing grounds and their biologically linked habitats, such as spawning or nursery areas;
- Use of compensation schemes, including retraining, community investment, or disruption payments; and
- Agreements on multiuse areas.[49]

Figure 14.17 shows the location of municipal and regional fishing ports in the Philippines. Municipal ports are under the jurisdiction of local harbor authorities to ensure management of local government statutory requirements. Regional ports follow the existing regulations established within different port districts through the country as per the Philippine Ports Authority guidelines, except for those in Cebu City which follow the Cebu Port Authority. Based on Figure 14.17, the majority of the potential OSW development zones are not expected to have any effect to commercial fishing grounds. Artisanal fishing grounds throughout the country should be assessed in due course and considered when locating OSW infrastructure. Due to the lack of spatial data at this stage, fishing areas have not been included as restrictions or exclusions.

FIGURE 14.17 COMMERCIAL FISHING PORTS



Source: see Table 9.1.

F. Aquaculture

Aquaculture is the cultivation of aquatic organisms such as fish, crustaceans, mollusks, and aquatic plants in a controlled environment for commercial and public purposes. Aquaculture is not only beneficial for food production, but also for protecting and improving stocks of endangered species. Marine aquaculture areas cover sea-based or lake-based cages, brackish water ponds, freshwater lakes and shallow bays fish pens, or suspended water columns.

Aquaculture contributes significantly to the country's food security, employment, and earnings. Development of an OSW project near aquaculture areas can disturb marine species, leading to displacement or reduction in fish (tilapia or milkfish), shrimp, shellfish, and other resources. Further, this will affect the aquaculture businesses, and those working in this industry.

Established aquaculture sites should be avoided by developers to mitigate disturbance of spawning areas and the habitat of marine species. Other options include marine spatial planning for identification and establishment of aquaculture management areas (clusters), and multiuse areas as well as assessing potential for coexistence of aquaculture activities with OSW.

Biological and technical studies have demonstrated the general feasibility of co-location between marine aquaculture and OSW projects, but socioeconomic and technical challenges would still need to be addressed.[51] An example of OSW coexisting with aquaculture is the demonstration project in Buan, South Jeolla Province in the Republic Korea where a wind turbine foundation incorporates artificial reefs and an aquaculture system. As OSW generally are further from the shore than aquaculture areas and due to the lack of spatial data at this stage, aquaculture areas have not been included as restrictions or exclusions.

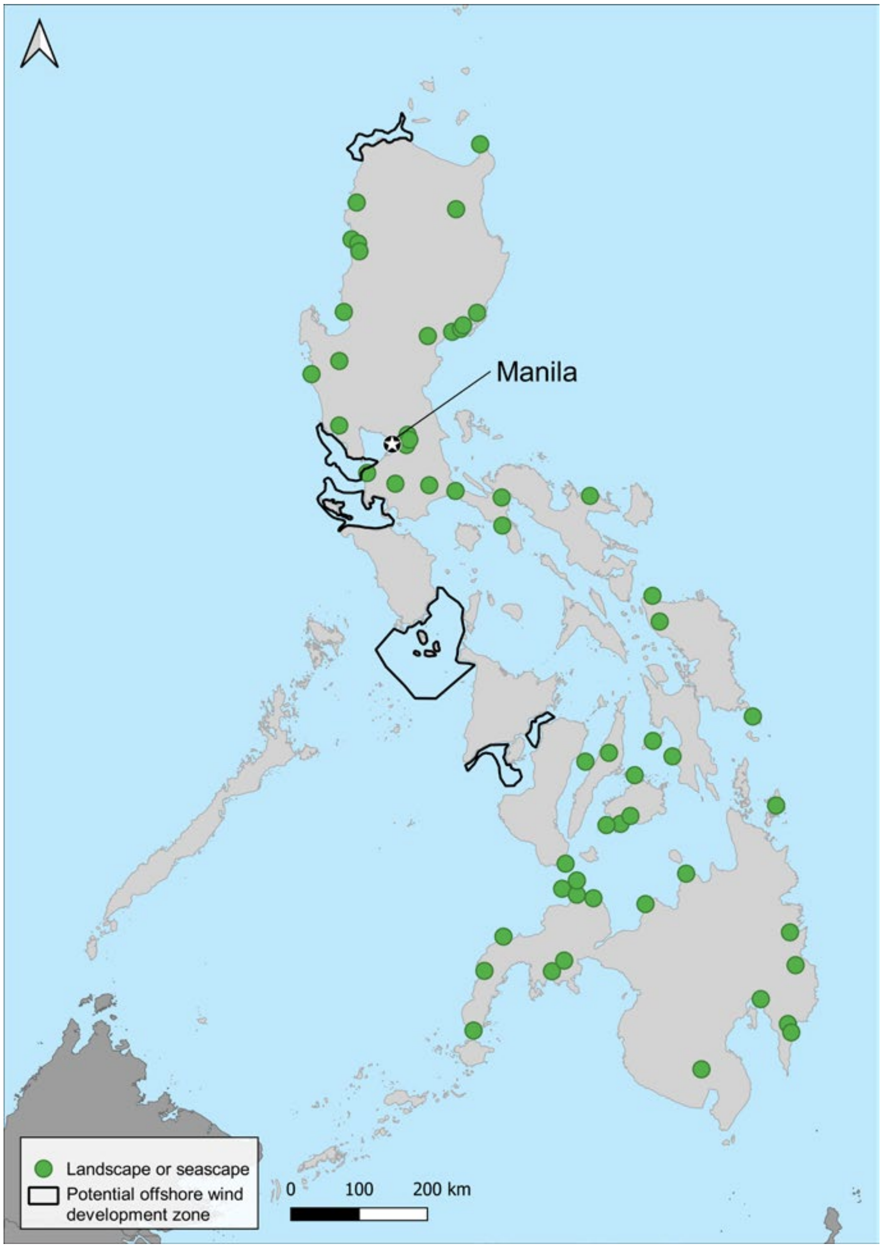
G. Landscape and seascape

Protected landscape and seascape in the country that are close to the potential OSW development zones are Roosevelt Protected Landscape, and Taal Volcano nearby the Manila OSW development zone. OSW project development may affect the aesthetic value of landscapes and seascapes, especially those near heritage and cultural sites, tourism locations, and forest areas that are protected under the local and national legislations.

OSW development is prohibited within or near landscape or seascape under ENIPAS Act of 2018 since these areas are considered as exclusions. Landscapes and seascapes in the ENIPAS Act are considered restrictions. Buffer zones to OSW projects will depend on local government unit (LGU) existing ordinances/laws (if any) and/or project impact such as shadow flicker, noise, and vibration effects, to be derived through modelling.

Stakeholder engagement and avoiding protected landscapes and seascapes through marine spatial planning is key to addressing this consideration. Protected landscape and seascape areas are shown in Figure 14.18. At this preliminary stage, landscape and seascape considerations have not been included as restrictions or exclusions.

FIGURE 14.18 PROTECTED LANDSCAPE AND SEASCAPE AREAS IN THE PHILIPPINES



Source: see Table 9.1.

H. Historical and cultural areas

This includes shipwrecks, sunken aircraft, war graves, coastal historical and heritage sites, and religious and ceremonial areas. Examples of historical and cultural sites in the country are

- Apo Reef, 80 kilometers from the northern Mindoro potential OSW development zone;
- Calapan Church, 30 kilometers from northern Mindoro potential OSW development zone;
- Corregidor Island, within the Manila potential OSW development zone;

- Silay City historical landmark, less than 10 kilometers from the Guimaras Strait potential OSW development zone; and
- Miagao Church beside Negros/Panay West potential OSW development zone.

Buffer zones between OSW and historical/cultural areas will depend on existing LGU ordinances/laws (if any) and/or project impacts that are usually based on shadow flicker, noise, and vibration effect. Buffer zones based on project impacts will be determined through modelling.

Early identification of important heritage sites through marine spatial planning is recommended to minimize harm and local conflict. It is possible, however, that important sites and finds may arise during the ESIA process and from stakeholder engagement. Protection of underwater archaeology and historical settings may need to be secured through the permitting process. OSW development potentially affecting these areas should be verified with NCIP through a clearance application in compliance with the international standards and Philippine Republic Act No. 8371 or the Indigenous Peoples Act of 1997[52] for protection of the rights of Indigenous and Cultural Communities in these areas.

Protection of underwater archaeology and historical settings may need to be secured through the permitting process. It is required to secure a Certificate of Precondition, if found within a known ancestral domain, or a Certificate of Non-Overlap if the area does not overlap any ancestral domain.

At this preliminary stage, known historical and cultural areas have been considered, but not modelled as restrictions or exclusions.

I. Tourism areas

The Philippines is well known for its tourist destinations which are mostly situated on the coast, providing access to the marine environment. As an example, Bangui-Pagudpod Beach and Paoay Lake National Park are located near the Northwest Luzon OSW, and Corregidor Island is within the Manila OSW. Tourism is an important source of economic activity, and livelihoods, as well as supporting balance of trade.

Buffer zones between OSW and tourist areas will depend on existing LGU ordinances/laws (if any) and/or project impacts determined through modelling.

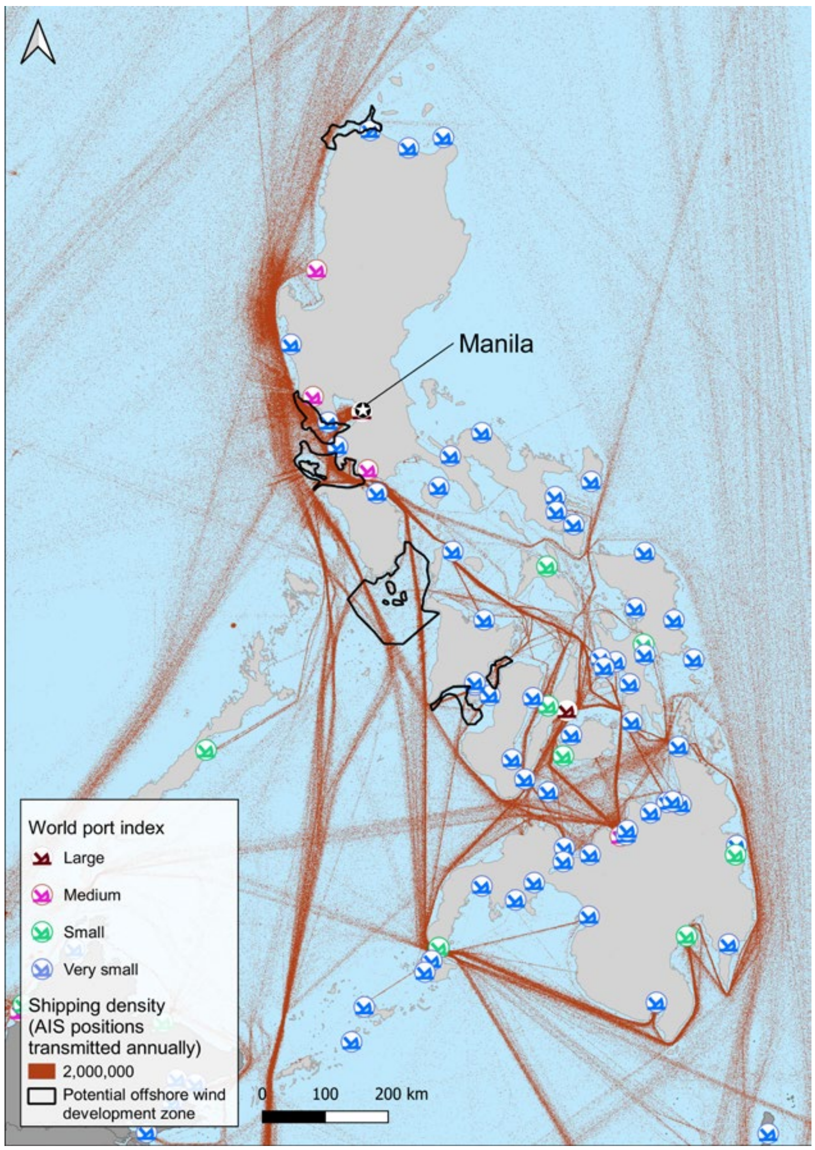
International experience suggests that OSW developers avoid areas with important tourism activities, but it is relevant to note that early OSW projects create local tourism opportunities. Public consultation is key to managing this consideration. At this preliminary stage, known tourism areas have been considered, but not modelled as restrictions or exclusions. Future potential tourism ports are shown in Figure 9.6.

J. Ports and shipping routes

OSW development near ports and shipping routes creates risk of collision. Exclusion zones and minimum safety zones are required during construction and operational stages.

Figure 14.19 illustrates the location sites of shipping ports in the Philippines which need to be considered when developing OSW projects. Figure 14.19 shows ports as classified by the World Port Index (using the 'Harbor Size' attribute), and areas of high shipping density.[xxi] At this preliminary stage, ports and shipping routes have been considered, but not modelled as restrictions or exclusions. See Section 9.3.

FIGURE 14.19 PORTS AND SHIPPING ROUTES



Source: see Table 9.1.

xxi The classification of harbor size is based on several applicable factors, including area, facilities, and wharf space. It is not based on area alone or on any other single factor.

K. Military exercise areas

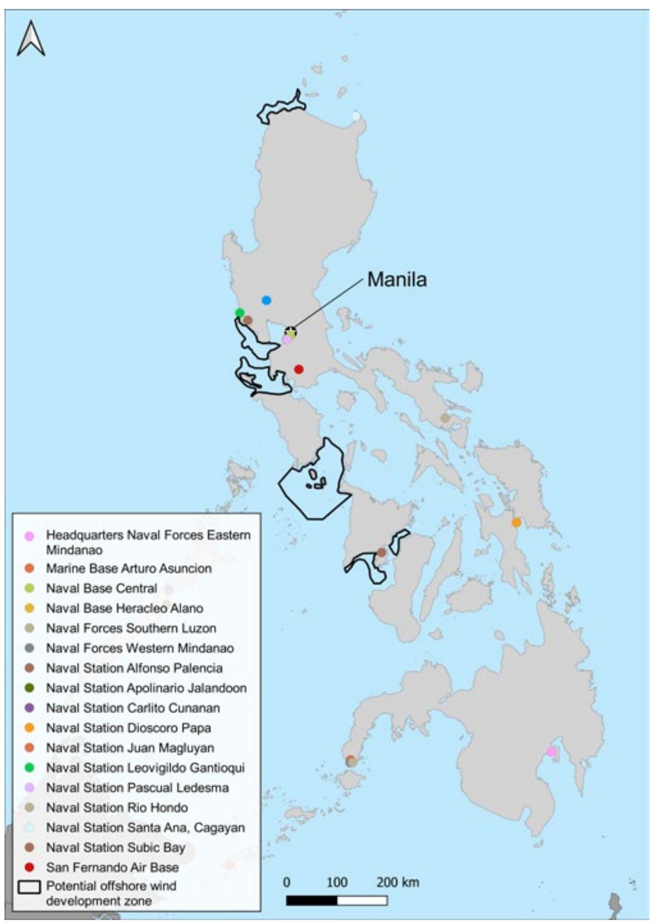
Military activities, such as vessel maneuvering exercises, firing practice, low-fly training, and testing of ammunition and other technologies are in most cases not compatible with OSW projects and pose a hard constraint.

Although, no known military areas are located within the OSW development zones, naval and air bases near the potential OSW development zones should be assessed. Samples of military bases within proximity of OSW development zones are Basilio Fernando Air Base which is approximately 27 kilometers to Manila OSW and the Naval Station in Alfonso Palencia which is less than 12 kilometers to Negros/Panay OSW and is 15 kilometers away from Guimaras OSW. Military bases are shown in Figure 14.20.

The buffer zone between military bases and OSW sites will depend on the prevailing LGU ordinances/laws (if any) and/or project impacts such as flicker, noise, radar impact, shadow, and vibration effects. These need to be assessed through modelling.

Early consultation with the DND, coordination with coast guard, and clearance application for OSW development are keys to managing this consideration. It is likely to lead to exclusion zones, and site-specific restrictions. With this, military areas are considered as restrictions.

FIGURE 14.20 MILITARY BASES IN THE PHILIPPINES



Source: see Table 9.1.

L. Aviation

OSW turbines pose a risk to the aviation sector in terms of physical obstruction, air defense and civil aviation radar interference and potential negative effects on the performance of communication and navigation systems.[53] Air traffic control centers, airports, and air traffic zones can pose constraints on constructing OSW.

Consultation with CAAP is key to managing this consideration. It is likely to lead to exclusion zones, and site-specific restrictions, for example on wind turbine tip height restrictions. Airports are shown in Figure 9.6.

At this preliminary stage, aviation considerations have been considered, but not modelled as restrictions or exclusions.

14.4 REGULATORY FRAMEWORK REVIEW

This section discusses Philippine national laws and policies associated with environmental and social aspects of the development of OSW projects.

The Philippine Environmental Impact Statement System

The Philippine Environmental Impact Statement System (PEISS) was introduced in 1977 with the issuance of the Philippine Environmental Policy Law through Presidential Decree 1151. It was established by virtue of Presidential Decree 1586 in 1978 as *Establishing an Environmental Impact Statement System, Including Other Environmental Management Related Measures and For Other Purposes.*[54]

Presidential Decree 1586 requires projects that are classified as environmentally critical or operating in an ECA to secure an Environmental Compliance Certificate (ECC) prior to commencement of construction.[55]

Environmentally Critical Areas

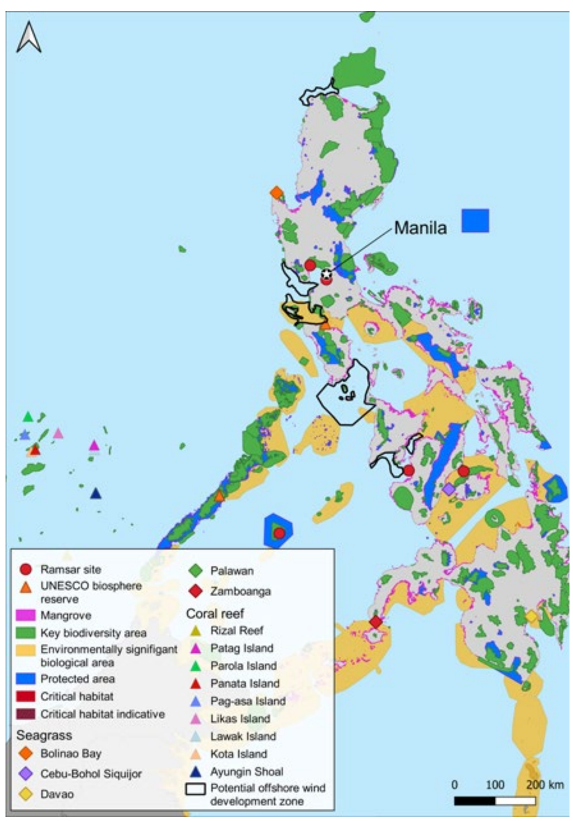
Areas that are environmentally sensitive and listed under Presidential Proclamation No. 2146, series of 1981 as well as other areas which the President may proclaim as environmentally critical in accordance with Section 4 of PD 1586.[56] With this, OSW development should be avoided near these environmentally sensitive areas to prevent substantial mitigating measures, extensive stakeholder engagement, and longer ESIA. A map of ECAs in the country is shown in Figure 14.21.

According to Proclamation No. 2146, an area is considered to be environmentally critical if it exhibits any of the characteristics described below.

- All areas declared by law as national parks, watershed reserves, wildlife preserves, and sanctuaries
- Areas set aside as aesthetic potential tourist spots
- Areas which constitute the habitat for any endangered or threatened species of indigenous Philippine Wildlife (flora and fauna)
- Areas of unique historic, archaeological, or scientific interests
- Areas which are traditionally occupied by cultural communities or tribes

- Areas frequently visited or hard-hit by natural calamities
- Areas with critical slopes
- Areas classified as prime agricultural lands
- Recharged areas of aquifers
- Water bodies characterized by one or any combination of the following conditions:
  - Tapped for domestic purposes
  - Within the controlled and/or protected areas declared by appropriate authorities
  - Support wildlife and fishery activities.
- Mangrove areas characterized by one or any combination of the following conditions:
  - With primary pristine and dense young growth
  - Adjoining mouth of major river systems
  - Near or adjacent to traditional productive fry or fishing grounds
  - Act as natural buffers against shore erosion, strong winds and storm floods
  - On which people are dependent for their livelihood.
- Coral reefs characterized by one or any combinations of the following conditions:
  - With 50 percent and above live coralline cover
  - Spawning and nursery grounds for fish
  - Act as natural breakwater of coastlines.

FIGURE 14.21 MAP OF ECAS



Source: see Table 9.1.

Environmental Compliance Certificate

ECC is issued by the DENR-EMB certifying that the applicant has complied with all the requirements of the PEISS and has committed to implement its approved Environmental Management Plan (EMP). The ECC also provides guidance to other agencies and to LGUs on environmental impact assessment (EIA) findings and recommendations, which they need to consider in their respective decision-making process.

The level of documentation required to secure an ECC depends on the categorization of the project. Current project screening and categorization guidelines by the DENR-EMB are presented in Table 14.4.[57] Practically, this means that all OSW projects rated over 100 MW are classified under Category B and an EIA report (rather than a less onerous Initial Environmental Examination Report) will be required to be submitted to the DENR-EMB, even if the project site traversed or will be located near an ECA.

TABLE 14.4 DENR-EMB CATEGORIZATION FOR WIND ENERGY PROJECTS

Category	Description
A	Projects or undertakings which are classified as Environmentally Critical Projects (ECPs). Proponents of these projects implemented from 1982 onward are required to secure an ECC.
B	Projects or undertakings which are not classified as ECPs under Category A, but which are likewise deemed to significantly affect the quality of the environment or located in an ECA. Proponents of these projects implemented from 1982 onward are required to secure an ECC.
C	Projects or undertakings not falling in Categories A or B, which are intended to directly enhance the quality of the environment or directly address existing environmental problems.
D	Projects or undertakings that are deemed unlikely to cause significant adverse impact on the quality of the environment according to the parameters set forth in the Screening Guidelines. These projects are not covered in the PEISS and are not required to secure an ECC. However, such non-coverage shall not be construed as an exemption from the compliance with other environmental laws and government permitting requirements such as submission of Project Description Report for Certificate of Non-Coverage approval.

Energy Virtual One-Stop Shop Act (EVOSS)

Republic Act No. 11234 of the Energy Virtual One-Stop Shop Act (EVOSS) established set of rules and regulations to streamline online application process of permits and certifications for power generation, transmission, or distribution projects. This online system allows coordination and simultaneous submission and processing of all required data and information and provides a single decision-making portal for actions on permit or certification applications necessary for or related to application of energy-related project. The DENR, under EVOSS, requires the following items as part of the ESIA process:

1. LGU clearance, business permit, endorsements, or resolution for no objection on the project
2. Permits such as ECC, Foreshore Lease Agreement, and clearances from related government agencies such as Bureau of Fishers and Aquatic Resources (BFAR), The Department of Tourism (DOT), Philippine Coast Guard, The Department of Energy (DOE), and so on.

Comparison with WBG ESIA requirements

The World Bank Environmental and Social Framework and the IFC Sustainability Framework promote sound environmental and social practices, transparency, and accountability. These frameworks define client responsibilities for managing risks and ensure that offshore wind sector preparatory work is aligned with good international industry practice (GIIP). Many international lenders also require that projects receiving their investments meet GIIP and align with WBG's E&S standards.

Aligning with GIIP standards allows developers to understand the most important issues to address in ESIA and gives a useful early indication of the scale of mitigation requirements of a project. As well as informing the scope of the ESIA, this information can also influence project feasibility decisions before the permitting process is too far advanced. If national permitting requirements are not aligned with international lender requirements, this can delay or even preclude permitted projects from proceeding.

There are some similarities between the requirements of PEISS and WBG's E&S standards. These include the identification of some of the key E&S components to be assessed as part of an ESIA such as biodiversity, land use restrictions, noise, air, and water quality, and impacts on landscape/seascape.

PEISS only specifies general surveys and monitoring requirements, which are common to all project types. While strong in terms of the need for baseline sampling (depending on the category of the project and the requirements of the review committee), Philippines EIS does have significant gaps when compared to international standards with respect to duration of sampling, extent of sampling and analysis in terms of Critical Habitat Assessment. Variations in specific environmental monitoring requirements and sampling periods are normally suggested during consultation with the DENR.

In terms of social aspects, there are significant differences between the two requirements. In particular, WBG standards require consideration of economic development, poverty reduction, gender inclusion, and vulnerable groups.

14.5 DISCUSSION

This section describes and rates relevant environmental and social considerations. Section 9 discusses the impact of these on the location of OSW projects in the Philippines.

The preliminary comparison of local standards and practices shows shortfalls compared to WBG requirements and GIIP. The absence of clear government guidance and standards for ESIA aligned with GIIP and lender requirements risks leading to

- Adverse environmental and social impacts;
- Delays to financing projects; and
- Damage to the reputation of the industry, slowing inward investment opportunities, and future growth prospects.

14.6 RECOMMENDATIONS

Based on this analysis, it is recommended that:

- The DENR addresses shortfalls in the Philippines ESIA requirements compared to those of the International Finance Corporation (IFC), GIIP, and other lender standards.
- The DOE continues further site screening and investigations on the potential OSW development zones to determine possible environmental and socioeconomic constraints and hence level of suitability for further development of OSW as part of a wider OSW marine spatial planning activity, especially considering cumulative assessment. Stakeholder engagement is critical to understand perceptions and concerns and explore mitigation measures.

15. HEALTH AND SAFETY

15.1 PURPOSE

The management and regulation of health and safety (H&S) is a vital aspect of developing a sustainable and responsible OSW industry. The purpose of the work package is to undertake a high-level review of applicable H&S guidance and law in the Philippines, to understand how this guidance and law aligns with OSW requirements and to identify areas for improvement, where required.

15.2 METHOD

Our assessment has been based on our existing knowledge of OSW H&S issues, primary research in relation to H&S frameworks in the Philippines, engagement with local partners with direct knowledge of marine operations in the Philippines, and discussions with active project developers.

15.3 FEEDBACK FROM DEVELOPERS

The H&S practice the renewable energy industry is required to follow is the Department of Energy (DOE) Circular No. DC 2012-11-0009, otherwise known as the *Renewable Energy, Safety, Health and Environment Rules and Regulations* (RESHERR).[58] This was created pursuant to Republic Act No. 9513 (the Renewable Energy Act of 2008) and Section 5 of Republic Act No. 7638 (the DOE Act of 1992). Pursuant to Rule 2, Section 8 of the circular DC2012-11-0009, a further circular has been drafted, the *Safety, Health and Environment Code of Practice for Wind Energy Operations*, to be adopted in the Philippines.[59] The code of practice as it stands is generally suitable for onshore works but does not address many of the typical H&S issues relevant to the OSW industry. Therefore, the OSW industry will need to generally follow the principles of regulations already in place for the offshore oil and gas industry in the Philippines with the understanding that not everything will be covered by these regulations and that a pragmatic approach will be required in the early years.

Developers expect to use design standards based on international good practice, with Philippine standards followed when they exceed international standards, recognizing that local law prevails.

Developers expect to specify the various H&S standards that will be relevant during construction and operation and ensure contractors have access to the necessary resources to be able to properly implement these standards.

In addition to applying international standards, developers expect to use experienced personnel from other regions for the training and development of operational personnel in the Philippines.

15.4 RESULTS

The OSW industry in the Philippines is in its infancy and no construction has yet been undertaken. This section therefore first considers relevant existing regulations and standards and then discusses the interim and future position for OSW.

Philippines law differentiates Occupational Safety and Health (OSH) Rules and Regulations that will apply between maritime and non-maritime workers on offshore projects. Works on land fall under the jurisdiction of the Department of Labor and Employment (DOLE) for which the Philippine OSH standards apply.

Onshore activity: Occupational Safety and Health Standards

The legal provisions on OSH in the Philippines come from the Occupational Safety and Health Standards (OSHS) which were formulated in 1978 under the tripartite agreement by the Bureau of Working Conditions (BWC) of the DOLE, the International Labour Organization (ILO) Manila Office, and the private sector in compliance with the constitutional mandate to safeguard workers' social and economic well-being as well as their physical safety and health. Department Order No. 13, also known as *Guidelines Governing Occupational Safety and Health in the Construction Industry*, was created in 1998.

The DOLE has exclusive jurisdiction in the preparation of OSHS for the construction industry including its enforcement, as provided for by law.

As embodied in Article 162, Chapter 2, Title I of Book Four of The Labor Code of the Philippines, "The Secretary of Labor and Employment shall by appropriate orders set and enforce and health hazards in all work-places and institute new and update existing programs to ensure safe and healthful working conditions in all places of employment."[60]

As embodied in Article 165, Chapter 2, Title I of Book Four of The Labor Code of the Philippines, "(a) The Department of Labor and Employment shall be solely responsible for the administration and enforcement of OSH laws, regulations and standards in all establishments and workplaces wherever they may be located."[62]

Onshore activity: Department of Energy renewable energy guidelines

Under Republic Act No. 9513, the DOE is mandated to supervise and control all plans, programs, projects, and activities of the government related to energy exploration, development, utilization, distribution, and conservation.

This was supplemented by RESHERR which details the H&S rules and regulations governing all renewable energy-related projects. The contents are not specific to either onshore or OSW projects. These rules will be further supplemented by the Code of Practice for Wind Energy Operations, which is in draft form at the time of writing. The draft Code of Practice focuses on onshore wind activities and could be extended to also cover offshore works.

Offshore activity: Maritime Industry Authority jurisdiction

While in theory the OSW activities are to be covered by RESHERR, there is not much mention of the H&S risks associated with works undertaken offshore, and industry assumes that other existing, relevant regulations would still apply. If it is by sea, jurisdiction falls under the Maritime Industry Authority (MARINA), an attached agency of the Department of Transportation (DoTr). MARINA covers regulations governing commercial, recreational, and technical maritime vessels within the Philippine territorial waters.

By virtue of Republic Act No. 9295, MARINA assumed responsibilities in making sure that all marine vessels within the territorial jurisdiction of Philippine waters are regulated to ensure H&S of all passengers and crew. This gives MARINA rights to

- Ensure all relevant vessels are registered;
- Issue certificate of public convenience or any extensions or amendments thereto, authorizing the operation of all kinds, classes, and types of vessels in domestic shipping;
- Set safety standards for vessels in accordance with applicable conventions and regulations;
- Require all domestic ship operators to comply with operational and safety standards for vessels set by applicable conventions and regulations; maintain its vessels in safe and serviceable condition; meet the standards of safety of life at sea and safe manning requirements; and furnish safe, adequate, reliable, and proper service at all times;
- Inspect all vessels to ensure and enforce compliance with safety standards and other regulations; and
- Adopt and enforce such rules and regulations which will ensure compliance by every domestic ship operator with required safety standards and other rules and regulations on vessel safety.

However, there is no mention of the OSW industry. MARINA is also responsible for overseeing the implementation of the 1978 *International Convention on Standards of Training, Certification and Watchkeeping for Seafarers*, as amended.

Oil and gas regulations

The Oil Industry Management Bureau (OIMB), an agency attached to the DOE, is mandated to formulate and implement policies, plans, programs, and regulations on the downstream oil industry, including the import, export, stockpiling, storage, shipping, transportation, refining, processing, marketing, and distribution of petroleum crude oils, products, and by-products. OIMB also monitors developments in the downstream oil industry.

The existing oil and gas regulations derived under the provisions of the OSH rules in the Philippines and formulated in 1978 under the tripartite agreement by BWC, the ILO, and the private sector provide details on safety management for all operations including search, exploration, processing, storage, and transport of oil and gas.[62] The regulations cover the following:

- Safety management program (including policies, objectives, safety activities, national and international regulations, and a compliance assessment)
- Risk assessment reports

- Emergency response plan
- Responsibility of organization of individual for safety management (including materials, safety and risk management, emergency response, occupational safety, personnel training, and qualifications)
- Safe design and construction of facilities (including general requirements, hazardous area classification, and firefighting and prevention)
- Safe operation of facilities (including facility operation and maintenance management, communication, transportation of people and cargo, work permits, wind farm vessels, and safety zones)
- Inspection, investigation, and reporting system (including safety inspection, incident or accident investigation, and reporting systems).

ILO Code of Practice 82B09, *Safety and health in the construction of fixed offshore installations in the petroleum industry*, is similar to the Philippine OSHS except that the latter does not have standards or rules and regulations pertaining to rescue or pick-up by boats, access between vessels and installations, survival craft and life rafts, operations of helicopters, landing areas, and control of helicopter movements which are relevant for OSW.[63]

Regulations and industry good practice in established markets

To determine any gaps in the current Philippine regulations and determine areas for improvement, it is important to understand the various H&S documents that are applicable to OSW activities globally. Table 15.1 lists the various H&S legislation documents that are commonly used around the world, along with some that are specific to the United Kingdom. UK-specific guidelines have been used here as an example of a market that is more established than the Philippines market. While some UK-specific regulations have been included, the vast majority are international standards (that have also been applied to UK projects) and, as indicated by developer feedback, the intention is to apply these to OSW projects in the Philippines.

Chapter 3.8 of the World Bank Group's *Key Factors* report also provides additional relevant information.[4]

TABLE 15.1 RELEVANT HEALTH AND SAFETY LEGISLATION AND GUIDANCE DOCUMENTS (UK/WORLDWIDE)

Project Stage / Area	Document	Summary	Applicable to the Philippines projects
Design	DNVGL-ST-0145, Offshore Substations for Wind farms	General safety principles, requirements, and guidance for platform installations associated with offshore renewable energy projects (substations)	Yes (international standard applied globally)
Design	DNVGL-ST-0126, support Structures for Wind Turbines	General principles and guidelines for the structural design of wind turbine supports	Yes (international standard applied globally)

Project Stage / Area	Document	Summary	Applicable to the Philippines projects
Design	DNVGL-ST-0437, Loads and Site Conditions for Wind Turbines	Principles, technical requirements, and guidance for loads and site conditions of wind turbines	Yes (international standard applied globally)
Design	IEC 61400, Wind Turbine Generator Systems	Minimum design requirements for wind turbines	Yes (international standard applied globally)
Design	CAP 437, Standards for Offshore Helicopter Landing Areas	Criteria required in assessing the standards for offshore helicopter landing areas	Yes (UK standard but typically applied internationally)
Design, operation	EN 50308: Wind Turbines - Protective Measures - Requirements for Design, Operation and Maintenance	Defines requirements for protective measures relating to H&S of personnel	Yes (international standard applied globally)
Design, operation	DNVGL-ST-0119, Floating Wind Turbine Structures	Principles, technical requirements, and guidance for design, construction, and inspection of floating wind turbine structures	Yes (international standard applied globally)
Construction	Construction Design and Management (CDM) Regulations	Regulations to cover the management of health, safety, and welfare when carrying out construction projects in the UK	No (UK specific and there may already be similar in place in the Philippines)
Operation	Safety of Life at Sea Regulations (SOLAS)	Sets minimum safety standards for life saving appliances and arrangements	Yes (international standard applied globally)
Various	G+ Good Practice Guidelines and Safe by Design Workshop Reports	Good practice guidance intended to improve the global H&S standards within OSW farms and workshop reports that explore current industry design and investigate improvements	Yes (international standard applied globally)
Various	RenewableUK H&S Publications	Various H&S guidelines for OSW farms including emergency response guidelines	UK specific but may be applied internationally
Various	World Bank General and industry-specific Environmental, Health, and Safety Guidelines	Minimum requirements for obtaining finance from World Bank and other international lenders	Yes (applied globally)

In the UK, the Construction, Design and Management (CDM) regulations apply to most construction projects, while the DNVGL-ST guidelines are the main global standards for offshore substations and wind turbines.

G+ is the global H&S organization bringing together the OSW industry to work on incident data reporting, good practice guidelines, safe by design workshops, and learning from incidents. The guidance is intended to be used by all to improve global H&S standards within OSW farms.

The various G+ and RenewableUK guidelines have been developed specifically for the wind industry (offshore and onshore) and are used in conjunction with the DNV-GL guidelines.

It should be noted that this is not an exhaustive list but just the main legislation and guidance applied to OSW projects. Many international standards are applicable for specific design areas, including EN, ISO, and IEC standards.

Current process

Under the current regulations, the developer is required to submit a Health, Environment, and Safety Plan and Job Hazard Analysis before the commencement of any physical works, which will be examined by both the DOE and the local authority having jurisdiction of the proposed development site. The government will notify the relevant organization or individual on the status of submission—whether it has been accepted or if further work or modifications are required. The local authority may then carry out on-site inspections and hold verification meetings.

15.5 DISCUSSION

The Philippines does not currently have any H&S regulation in place specifically for the OSW industry. Experience with other emerging OSW markets has shown that in advance of specific guidelines being available for the OSW market, project developers have made use of international regulations, standards, and guidelines in conjunction with any overarching guidelines in place for the country. Feedback from developers is that they expect to do the same in the Philippines, using

- International regulations, standards, and guidelines, as listed in Table 15.1 and
- Philippines OHS, OIMB guidelines, and RESHERR, supplemented by the Code of Practice for Wind Energy Operations when available.

Based on this, it is important for all to be clear on the legal basis, what national regulations and guidelines apply, and how conflicting requirements are addressed.

Behavioral H&S training also forms an integral part of modern H&S frameworks and has been widely adopted and applied in the OSW industry. The Philippines can benefit from international experience by involving experienced developers, suppliers, and training providers from other more established OSW markets.

15.6 RECOMMENDATIONS

Based on this analysis, it is recommended that the DOE

- Extends RESHERR to cover health and safety for OSW and
- States in any updated guidance specific to OSW that experienced personnel from other regions should be involved and train local personnel. Guidance should have a firm focus on the behavioral aspects of H&S and ensure that ongoing behavioral training forms a core element of compliance, enabling establishment of a strong H&S culture.
-

16. LEASING AND PERMITTING

16.1 PURPOSE

Balanced, transparent, and efficient processes for granting contract areas and permits are required for the Philippines to deliver the significant volumes of OSW in the scenarios presented in Section 2.

In this work package, we examine how leasing and permitting of OSW is currently managed in the Philippines. We identify gaps that need to be addressed to ensure the processes are suitable for the expected increase in the volume of projects seeking permits and provide recommendations for improvement to underpin the development of a sustainable OSW industry in the Philippines. In Section 17, we cover the next stage for OSW projects, securing a revenue for energy produced.

16.2 METHOD

We have mapped the regulatory processes that apply when an OSW developer wishes to secure

- An exclusive right to explore, develop, and utilize OSW resources over a specific contract area, including access to lands, offshore areas, and seabed, identified by the developer and approved by the Philippine Government through model renewable energy service contracts (RESCs) or in the case of wind resources, through wind energy service contracts (WESCs) under which OSW energy resources are harnessed and

- All necessary permits, licenses, and clearances from other agencies of the national government, local government units (LGUs), and other government departments and instrumentalities to allow construction to proceed.

These processes were mapped based on existing Philippine laws and regulations and engagement with relevant stakeholders in the Philippines such as project developers and national government departments and agencies, including

- DOE;
- Board of Investments (BOI) under the DTI;
- ERC; and
- DENR.

16.3 RESULTS

Key Legislation

The following are the main laws that govern OSW energy in the Philippines:

- 1987 Constitution of the Philippines
- Executive Order No. 462, Ocean, Solar and Wind Energy Resources Exploration
- Department Circular No. 98-03-005, Rules and Regulations Implementing Executive Order No. 462
- Executive Order No. 232, Amendments to Executive Order No. 462
- Republic Act No. 9513, Renewable Energy Act of 2008
- Department Circular No. DC2009-05-0008, Rules and Regulations Implementing Republic Act No. 9513
- Department Circular No. DC2012-11-0009 on Renewable Energy Safety, Health and Environment Rules and Regulations
- Department Circular No. DC2019-10-0013, Omnibus Guidelines Governing the Award and Administration of Renewable Energy Contracts and the Registration of Renewable Energy Developers. [65,66,67,68,69,70,71]

Energy and wind resources

The 1987 Constitution of the Philippines adopted the legal concept of Regalian Doctrine in relation to ownership of all lands of the public domain and natural resources, including geothermal, solar, hydro, and wind. In its broadest sense, Regalian Doctrine or *jura regalia* means that all lands of the public domain, waters, minerals, coal, petroleum and other mineral oils, all sources of potential energy, fisheries, forests or timber, wildlife, flora and fauna, and other natural resources are owned by the State or the Philippine Government. The exploration, development, and utilization of these natural resources shall be under the full control and supervision of the Philippine Government. The State may directly undertake such activities, or it may enter into co-production, joint venture, or production sharing agreements with Filipino citizens or corporations or associations at least 60 percent of whose capital is owned by such citizens. For wind energy resources, these agreements come in the form of WESCs.

The DOE is the main government agency tasked to ensure continuous, adequate, and economic supply of energy resources with the end in view of ultimately achieving self-reliance in the country's energy requirements through the integrated and intensive exploration, production, management, and development of indigenous energy resources in the Philippines.[72] The DOE is mandated by law to prepare, integrate, supervise, and control all plans, programs, projects, and activities related to energy exploration, development, utilization, distribution, and conservation. In this regard, the DOE is the lead agency that issues WESCs. These are the service agreements between the Philippine Government, through the DOE, and the developer over a period of 25 years (extendible to another 25 years) in which the developer has the exclusive right to a particular area for exploration and development of the specific renewable energy resource.[73] The WESC is the primary OSW permit for OSW developers, which serves as the underlying basis to secure other necessary permits, licenses, endorsements, and clearances from all other relevant departments and agencies, especially the following:

- BOI under the DTI
- ERC
- The DENR
- The Department of Agrarian Reform
- National Commission on Indigenous Peoples (NCIP).[73]

Site identification and exclusivity

The first stage of pursuing an OSW project in the Philippines involves the developer identifying a specific contract area for development and filing a letter of intent (LOI) with the DOE for contract area exclusivity.[xxii]

Area verification

After submission by the developer of the LOI, the DOE conducts verification to determine whether the contract area chosen by the applicant is open for RESCs or WESCs.[74]

Area verification results

The verification report may indicate that the proposed contract area is

1. Covered by an existing Pre-Determined Area (PDA) identified by the DOE for public bidding purposes;
2. Within or overlaps the area of an existing energy service or operating contract such as Petroleum Service Contract (PSC), Small Scale Mining Permit (SSMP), or WESC, other than the renewable energy resource or technology being applied for;
3. Within or overlaps the area of an existing energy service or operating contract application such as PSC, SSMP, or RESC, other than the renewable energy resource or technology being applied for;
4. Within the protected areas under the *Expanded National Integrated Protected Areas System Act of 2018*, ancestral domains with Certificate of Ancestral Domain Title or Claim, areas with Tenurial Instruments from other government agencies, and other areas covered by significant geospatial data that will be identified as necessary in the evaluation of the renewable energy application based on available data on file at the DOE and the National Mapping Resource Information Authority's Philippine Geoportal Project website;
5. Covered by the LOI of the same or other energy resource; or
6. Open for RESC Applications.[75,76]

xxii In the Philippines, the site remains exclusive to the developer/investor as long as it can continue with the development and demonstrate its commitment. If it cannot, the WESC is cancelled.

Award of WESC

When the developer completes all requirements to prove its technical, legal, and financial qualification, the DOE awards the WESC to the developer based on a model template, with standard provisions adopted by the DOE and made applicable to all developers.

Offshore occupation fee

Executive Order No. 462 (1997) states that for offshore contract areas, an occupation fee of PHP50 (US$1) per hectare, or a fraction of a hectare, is to be paid by the developer to the treasurer of the host municipality or city immediately upon signing of the WESC and every year thereafter at the anniversary of signing.[77]

For offshore areas outside territorial jurisdiction of any municipality or city, Executive Order No. 462 (1997) states that the occupation fee shall be paid by the developer to the DOE immediately upon signing of the WESC and every year thereafter at the anniversary of the signing.

The above notwithstanding, the Renewable Energy Act, its implementing rules and regulations, the *Omnibus Guidelines Governing the Award and Administration of Renewable Energy Contracts and the Registration of Renewable Energy Developers,* and the model WESCs issued by the DOE to developers currently do not provide for any obligation of the developer to pay the occupation fee for OSW contract areas. The DOE has not imposed the occupation fee on any OSW developer that was recently awarded a WESC. At this time therefore, there is no occupation fee being charged to OSW developers.

Considering the obligations of the developer under the WESCs and the Renewable Energy Act, including the obligation of a developer to pay the Philippine Government 1 percent of the gross income resulting from the sale of renewable energy produced and such other income incidental to and arising from renewable energy generation and transmission, and considering further that Executive Order No. 462 (1997) predated the Renewable Energy Act and the model WESCs, we believe that the payment of offshore occupation fee should no longer be required.[79]

Seabed lease

The award of WESC concurrently grants to a developer access to seabed without any further need for a lease agreement.

The model WESC grants to the OSW developer exclusive right to explore, develop, and utilize wind energy resources within the contract area specifically identified by the OSW developer (the Contract Area). As part of the developer's rights under the WESC, the developer shall receive assistance from the DOE in securing access to lands and offshore areas where wind energy resources shall be harnessed. The model WESC also provides that the developer shall have, at all times, the right of ingress to and egress from the Contract Areas. Under the WESC, the DOE also grants the developer the right to acquire rights-of-way and similar rights on, over, under, across, and through the Contract Areas or properties adjacent to the Contract Area, which constitute or is reasonably expected to constitute the Contract Area as the developer may reasonably deem necessary.[66]

WESC application process and permits

In the Philippines, the application process for OSW power is governed by the provisions of the Omnibus Guidelines Governing the award and administration of renewable energy Contracts and the Registration of Renewable Energy Developers.[73]

Under this Department Circular, WESCs are awarded either through

- An open and competitive selection process (OCSP) or
- Direct application.

Each type of process is governed by a different procedure.[79] The procedure under OCSP includes publication of competition, pre-submission conference, submission and evaluation of documents, high-level approval, payment of signing fee and performance bond, and delivery of signed WESC.[80] Under existing DOE guidelines, the signing fee for WESC is PHP 100 (US$2) per hectare based on Contract Area granted to the developer.

This procedure has not been adopted by the DOE for OSW. The DOE has however reserved certain onshore areas with data already collected from onshore wind met masts of the DOE's Detailed Wind Resource Assessment Project and the Quantum Leap in Wind Power Development in Asia and the Pacific of the Asian Development Bank (ADB). The DOE is to extend its wind resource assessment campaign to cover offshore areas and may consider OCSP for pre-determined OSW areas in the future. The DOE determines and publishes the criteria for evaluating bids under OCSP.

The procedure under direct application includes submission of an LOI, area verification, submission and evaluation of WESC application, high-level approval, payment of signing fee and performance bond, and delivery of signed WESC.

Upon its award by the DOE, the WESC involves two stages.

Pre-Development Stage

The Pre-Development Stage involves conducting preliminary assessments and feasibility studies up to Final Investment Decision and Declaration of Commerciality (DOC) of the OSW project. During this period, the developer secures all necessary permits, licenses, and registrations from various national government departments, agencies, and LGUs. Under the model WESC, an OSW developer is granted a Pre-Development Stage period of five years from execution of the WESC to conduct these activities and thereafter submit a DOC to be duly confirmed by the DOE. Considering that WESCs for OSW have only been recently awarded in the Philippines, we have not yet seen any developer seek extension of this period. If there are justifiable grounds that are beyond the control of the developer, for example, force majeure events, the developer may seek extension of the Pre-Development Stage.

Development and Commercial Stage

The Development and Commercial Stage involves development, construction, and commercial operation of the OSW project, including the construction and installation of relevant facilities up to the operation phase of the project.[82] Upon approval of the DOC by the DOE, the WESC remains in force for the balance of a period of 25 years from execution of the WESC. At the option of the developer upon written notice to the DOE one year before expiration, the WESC may be extended by the DOE for another 25 years subject to terms and conditions to be mutually agreed upon by the developer and the DOE. Grid connection is discussed in Section 18.7.

In 2019, Philippine Congress passed into law the *Energy Virtual One-Stop Shop Act* (EVOSS) which created an online platform allowing the coordinated submission and synchronous processing of data and information relative to applications for energy projects. EVOSS hopes to streamline the leasing and permitting processes and requirements of all government agencies, instrumentalities, LGUs, government-owned or controlled corporations, and private entities involved in energy projects.[83] In July 2021, Executive Order No. 143 was issued creating the EVOSS Task Group to accelerate activity, composed of different government department heads and chaired by the Philippine President and assisted by the DOE Secretary as vice chairman.

With EVOSS, the Philippine Government aims to shorten the time frame for securing all necessary permits, licenses, and registrations for developing OSW projects. Table 16.1 provides an indicative list of substantive permits, licenses, and registrations necessary for developing OSW projects.

TABLE 16.1 LIST OF NECESSARY PERMITS, LICENSES, AND REGISTRATIONS FOR DEVELOPING OSW PROJECTS

Securities and Exchange Commission	**Bureau of Investments**
Article of Incorporation and By-Laws (for corporation/ joint venture/consortium/cooperative)	Certificate of Registration / Project Registration for Incentives
Registration of Stock and Transfer Book, if applicable	Certificate of Authority to Import relating to any duty-free equipment imported for the Power Plant
Bureau of Internal Revenue	**Bureau of Customs**
Payment of Documentary Stamp Tax	Registration and Accreditation as Importer
Certificate of Registration	Registration and Accreditation as Exporter
Registration of Books	**The Department of Energy**
Local Government Unit	Certificate of Endorsement for BOI Registration
Municipal and Barangay Resolutions of Support	Registration as Renewable Energy Developer
Business Permit	Wind Energy Service Contract
Bangko Sentral ng Pilipinas (BSP), the central bank of the Philippines	**The Department of Environment and National Resources**
Registration of Inward Foreign Investments	Environmental Compliance Certificate/ Certificate of Non-Coverage
The Department of Labor and Employment	Hazardous Waste Generator Registration
Letter of Approval of Construction Safety and Health Program	Pollution Control Officer Accreditation
Certificate of Electrical Inspection	Permit to Operate Air Pollution Source

Registration of Employer (for purposes of occupational safety and health standards)	Foreshore/ Miscellaneous Lease
Establishment Registration for Alien Employment Permit purposes (if applicable)	**Civil Aviation Authority of the Philippines**
Alien Employment Permit (if applicable)	Height Clearance Permit
National Commission on Indigenous Peoples	**The Department of Trade and Industry**
Certification Precondition / Certificate of Non-Overlap	Certificate of Registration (for individual or proprietorship)
Bureau of Immigration	
Alien Certificate of Registration Identity Card	
Special Work Permit	

16.4 DISCUSSION

Leasing

The award of a WESC by the DOE grants to a developer the exclusive right to explore, develop and utilize OSW resources over a specific contract area, including access to lands, offshore areas, and seabed, identified by the developer.

The WESC, by itself, is sufficient legal right to the developer. Under existing DOE guidelines, there is no separate agreement or permit required for the lease of OSW areas approved by the DOE under the WESC.

The Government is able to drive the location and timing of lease applications through defining OSW development zones and timely Transmission Development Plans. OSW development zones themselves are defined through marine spatial planning.

The five-year time frame for Pre-Development is typically insufficient for most of the +20 GW of WESCs already awarded (and for future awards), as it is likely that many of these projects will not have a grid connection for 10 to 15 years. It will be important for the DOE to provide clear guidance and firm but fair and transparent management of WESCs to

- Honor development activity;
- Challenge project developers not progressing, with the ultimate sanction of cancelling the WESC; and
- Not penalize project developers that realistically should only make slow progress to avoid high expenditures 'at risk' many years before commercial operation.

Permitting

The existing permitting process in the Philippines for OSW projects involves numerous national government departments and agencies and LGUs requiring submission of volumes of supporting documents. The Philippine Government hopes to streamline the permitting process through the implementation of the EVOSS.

The effective aspects of the current permitting process and key risks and issues in the Philippines are as follows:

- While an old executive issuance requires payment of occupancy fee for offshore areas, the Renewable Energy Act and its implementing rules and regulations, DOE issuances, and model WESC do not require payment of any occupancy permit fees.
- Standards of environmental and social impact assessment (ESIA) are not specific to OSW and do not meet GIIP for OSW farm development. Increased environmental and social risks and significant project delays can arise when GIIP or lender standards are not followed. Examples of differences are discussed in Section 14.4.
- Large number of different permits and letters of approval are required throughout development and construction, adding an administrative burden and slowing the delivery of projects.
- Pursuant to the EVOSS, changes are currently being made to existing guidelines to aid the development of OSW projects in the Philippines. Although welcome, this introduces uncertainty.
- Lengthy and bureaucratic permitting process system may dissuade developers from working in the Philippines or it will add to risk premium.
- No clear timelines and deadlines for permit approvals or compliance by government agencies make it hard to plan and finance projects.
- Inefficiency in administration throughout the permitting process adds to development risks and costs.
- No clear alignment or coordination between the national government departments and agencies and LGUs adds to uncertainty over the time frame for permits being issued.

16.5 RECOMMENDATIONS

Based on this analysis, the following is recommended to prepare for an increase in volume of projects seeking leases and permits:

Leasing

- The DOE builds capacity and knowledge needed to process a growing volume of OSW projects.
- The DOE issues appropriate guidance regarding applying for a WESC for OSW adjacent to an existing WESC.
- The DOE issues appropriate guidance to developers regarding the grounds for accepting requests to extend the Pre-Development Stage of a WESC (whether already signed or future) beyond five years due to considerations outside the control of the developer such as non-availability of a firm, timely grid connection agreement.
- The DOE gives assurance to developers on the expectation to extend a WESC after the initial 25-year term if a project is still in operation.
- The DOE confirms that there is no requirement for payment of offshore occupation fee.

Note that further discussion regarding foreign ownership of OSW projects is covered in Section 20.

Permitting

- The DOE fully implements the EVOSS to enhance and align coordination among different government departments, agencies, and LGUs. This will improve efficiency and minimize the risk of local delays holding up national renewable energy developments.
- The DOE ensures collaboration between all relevant ministries, authorities, and OSW organizations to deliver a more efficient process.
- The DOE clarifies and streamlines the permitting process, ensuring ESIA standards and stakeholder engagement requirements are in line with GIIP and lender standards, with specific guidelines for OSW development. This is likely to involve reducing the number of permits and approval letters required to avoid duplication and potential overlap.
- The DOE reviews the availability and appropriateness of supporting guidance regarding the permitting processes, considering all parties—developers, regulators and stakeholders—including clear timelines for permit decisions and prioritization of renewable energy projects.
- The DOE enables sufficient permit flexibility in design to prevent the need for full reapplication and subsequent delays should any design changes be required as the project progresses.
- The DOE facilitates environmental and social data sharing to improve efficiency and robustness of feasibility studies.
- The DOE leads in helping government departments and other key stakeholders to grow capacity and knowledge needed to process an increasing volume of OSW projects.

Note that a recommendation regarding improvements to ESIA standards is provided in Section 14.

17. PROCUREMENT OF ENERGY

17.1 PURPOSE

Robust, transparent, and efficient processes for procurement of large volumes of energy are critical to deliver OSW at the scale explored, especially in the high growth scenario.

In this work package, we examine how procurement of onshore renewables is currently managed in the Philippines and propose a solution for OSW.

17.2 METHOD

Through engagement and literature review, we have summarized the existing processes, designed for relatively small onshore projects.

OSW projects are typically designed to operate for at least 25 years. To recoup their investments, developers, lenders, and investors desire long-term visibility and certainty of the revenues a project will generate. Similar to other renewable energy projects, revenue certainty can be provided by long-term offtake agreements[xxiii] (PPAs) and government mechanisms to provide revenue support.

Through engagement with relevant stakeholders and a headline options analysis, we have proposed a solution for OSW, based on the following considerations:

- Continuity with existing arrangements, where possible, to minimize barriers to implementation;
- Future proofing, so that any system does not need to be changed significantly in a few years, which risks delaying the industry and reducing confidence;
- Ensuring projects awarded contracts enable projects to be constructed promptly and competently;
- Consumer value for money;
- Robustness, transparency and fairness; and
- Bankability.

xxiii Offtake agreements can take several forms, including Power Purchase Agreements (PPA), Feed-In Tariffs (FIT), Contracts for Difference (CFD), and bilateral agreements with corporate entities

17.3 RESULTS

Existing processes

Feed-in-tariff

To accelerate the development of emerging renewable energy resources, a feed-in tariff (FIT) system for electricity produced from wind, solar, ocean, run-of-river hydropower, and biomass is mandated under the Renewable Energy Act.[70] The DOE implemented the first FIT program after the ERC set the first FIT rates for biomass, solar, run-of-river hydropower, and wind in 2012. As a result, a total of approximately 1,400 MW of new renewable energy capacities were successfully installed under the FIT program. This program was successful because of the attractive FIT rates for a period of 20 years paid directly by the electricity end users through a payment system adopted by the ERC, priority connections to the grid, priority purchase and transmission of, and payment for such electricity by the grid system operator.

The DOE is planning to revise its current proposed Green Energy Auction Program (GEAP)[84] to apply the same FIT-concept framework as used in 2012. This means the National Transmission Corporation will act as FIT-fund administrator and collect a FIT allowance from all electricity consumers based on the FIT rates approved by the ERC. This makes it easier for renewable energy developers to collect their FIT rates from one administrator, rather than the current GEAP draft that requires individual power supply agreements with various distribution utilities.

The DOE has expressed its intention to implement the GEAP on an annual basis in the hope to reach at least 50 percent installed capacities of renewable energy in the Philippine energy mix by 2040.

Renewable Portfolio Standards

In 2017, to contribute to the growth of renewable energy in the Philippines under the Renewable Energy Act, the National Renewable Energy Board (NREB), with the approval of the DOE, mandated specific electric power industry participants, to source or produce at least one percent (1%) of their annual energy demand over the next ten years from eligible renewable energy resources. Under these Renewable Portfolio Standards (RPS) rules, the mandated participants include all distribution utilities and electric cooperatives for their captive customers, all suppliers of electricity for the contestable market and generating companies to the extent of their actual supply to their directly connected customers.

With the RPS, OSW developers can secure power supply agreements with the mandated participants. While most distribution utilities have small captive customer demand, Manila Electric Company (Meralco) which had an average peak demand of about 8 GW in 2020 is a viable counterparty.

Green Energy Option Program

In 2018, the DOE established the Green Energy Option Program (GEOP) that provides end users the option to choose supply from renewable energy projects. Under the GEOP rules, end users with at least 100 kW peak demand may directly contract with renewable energy providers for their energy requirements, distributed through their respective distribution utilities. As the largest end users of manufacturing plants, hotels, resorts, and shopping malls usually have a demand of only a few megawatts each, this option is not viable for OSW project developers.

17.4 DISCUSSION

Proposed process for offshore wind

World Bank Group's *Key Factors* report Sections 3.2 and 3.6 discuss different ways of organizing leasing and revenue frameworks and the different options available regarding energy procurement.[4] Taking the learning from this and following a headline options analysis, it is concluded that it would be detrimental to move to a single competition system (where service contract, permits, grid connection agreement and PPA are all awarded to the winner of the single competition) or to establish a route to market for OSW that is radically different from other technologies. Such changes cause delays, introduce risk, and decrease competition in the market.

It is proposed, therefore, that a refinement to GEAP is established solely for OSW projects. This will involve a competitive auction held between developers of projects soon before reaching final investment decision FID, and incorporate

- Prequalification criteria covering
  - Relevant permits
  - Grid Connection Agreement (GCA) for connection within an agreed time frame
  - Project deliverability to an agreed time scale, including availability of finance
  - Other technical criteria in line with good practice in established markets.
- A competitive bidding process, with bidders submitting evidence of lender endorsement of proposed price, to minimize the possibility of unviable bids.
- A ceiling price acceptable to government, consumers, and project developers for projects constructed toward the end of the decade, a realistic time frame for first projects, based on progress to date. This price could potentially be comparable to the cost of generation from plants constructed after recent auctions for coal. Such a ceiling reduces the requirement for technology-neutral auctions.
- A floor price (possibly) in the early stages to avoid the risk of lowball bids with a lack of precedent projects reducing price certainty on capital and operating costs that would come through a more established market.
- Standardized PPA terms, including curtailment arrangements. Robust, standardized terms will reduce uncertainty and enable FID on much larger projects than typical for onshore wind and solar, with capital investment of US$2 to 3 billion for a 1 GW project. At this scale, what happens when power is not required is critical. It is also critical to ensure bankability of the cumulative commitments of any offtaker to buy multiple GW of OSW output at given prices over many years. To finalize a form of contract, it is good practice to consider PPA contracts in other markets and discuss with project developers and other relevant stakeholders.
- A centralized coordinating body or alternative that can backstop private offtaker obligations for multiple GW-scale projects.

The precise details should be drafted by the DOE and agreed with industry and other relevant stakeholders, to ensure that all key considerations are met and equitable compromises found, where needed.

Many of the principles of the existing processes can be used, but due to the investment and infrastructure needed to deliver OSW, and the long-term benefits available, it is not feasible for OSW to enter auctions against small volumes of onshore wind and solar.

Over time, and for example as corporate PPAs and hydrogen start to play a larger role, there will always be a need to evolve the procurement arrangement but established markets have shown that stability (rather than constant changes seeking the optimum solution) is important.

Note that a typical competition bid price cannot be directly compared with a levelized cost of energy (LCOE) for two main reasons:

- PPA terms are typically for 20 to 25 years, shorter than the expected project lifetimes of more than 30 years.
- Actual bid prices will take into account taxation and other fiscal and financial considerations, including those specific to each bidder. These are not included in LCOE calculations.

17.5 RECOMMENDATIONS

Based on this analysis, it is recommended that to deliver a system fit for long-term use and a potentially large volume of projects, the DOE

- Establishes a competitive system solely for OSW PPAs, with a ceiling price to limit cost to consumers and considers a floor price to avoid the risk of lowball bids. Consultation on ceiling and floor prices should be conducted with relevant stakeholders in the run up to competitions to reflect evolving fossil fuel and OSW prices, especially recognizing high current high fossil fuel and commodity prices.
- Sets out a suggested timetable for private sector competitions, and coordinates across government and private sector to deliver.
- Explores how to ensure PPA counterparties (offtakers) and PPA terms remain viable as volumes of OSW contracted increase, including clarity on curtailment. The DOE ensures that PPA counterparties (offtakers) and PPA terms remain viable as volumes of OSW contracted increase

18. TRANSMISSION INFRASTRUCTURE

18.1 PURPOSE

In this work package, we examine the existing transmission network and transmission upgrades as well as changes in transmission network management that may be required to support development of OSW under the scenarios presented in Section 2.

We also review the processes that are used to manage grid connection applications and how upgrades are managed in the Philippines.

18.2 METHOD

Our assessment has been based on sources as cited within this section along with industry knowledge from which suggestions have been made for the upgrading of the transmission network to facilitate the development of OSW projects in the Philippines. It is recognized that parts of the proposed transmission network development and enhancement options will pass close to environmentally sensitive areas. This will need to be considered and incorporated during the planning and detailed option appraisals for the future transmission network upgrading works but should not fundamentally change the principles being promoted.

Environmental and social aspects have only been considered at a headline level and would need to be incorporated fully during future, more detailed, option appraisal.

18.3 CURRENT TRANSMISSION NETWORK

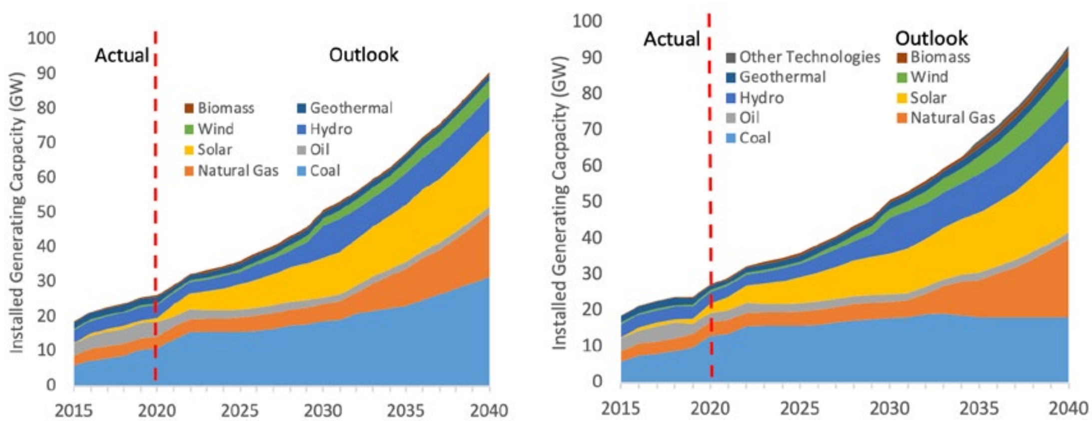
The Philippines transmission network is divided into three grids covering Luzon, Visayas, and Mindanao. The Luzon and Visayas grids are interconnected via 350 kV high-voltage direct current (HVDC), 440 MW submarine cables, and Mindanao remains an independent grid, pending completion of the 350 kV HVDC, 440 MW Mindanao-Visayas Interconnection Project.

In 2019, the existing transmission assets comprised a total of 36,436 MVA substation capacity and 20,079 circuit kilometers (ckt km) of cable which are owned by the government through the National Transmission Corporation (TransCo). This is operated and maintained by the National Grid Corporation of the Philippines (NGCP). The transmission system network consists of 500 kV, 230 kV, 138 kV, 115 kV, and 69 kV high-voltage alternating current (HVAC) and HVDC lines, as well as the 350 kV HVDC interconnectors, mentioned above, between Luzon and Visayas.

As of 2020, the system peak demand was 15 GW, with predictions for this to increase to 60 GW by 2040 due to economic growth. The Luzon grid contributed 11.1 GW or 73 percent of the total peak demand, while Visayas and Mindanao have a share of 14 percent (2.2 GW) and 13 percent (2 GW), respectively. As such, the system will require additional generation to satisfy the predicted increase in demand. This poses challenges for developing and reinforcing the transmission network, whatever new generation capacity is installed.

By the end of 2020, the Philippines had a total generating capacity of 26.3 GW, including embedded generation. Renewable energy (RE) projects include 3.8 GW hydro, 1.9 GW geothermal, 1 GW solar, 483 MW biomass, and 443 MW wind. Under the Reference scenario and the Clean Energy scenario of the Philippines Plan 2018–2040 by the Department of Energy (DOE), the total installed capacity reaches 90.6 GW and 93.4 GW by 2040, respectively, with considerable addition of RE sources as seen in Figure 18.1.

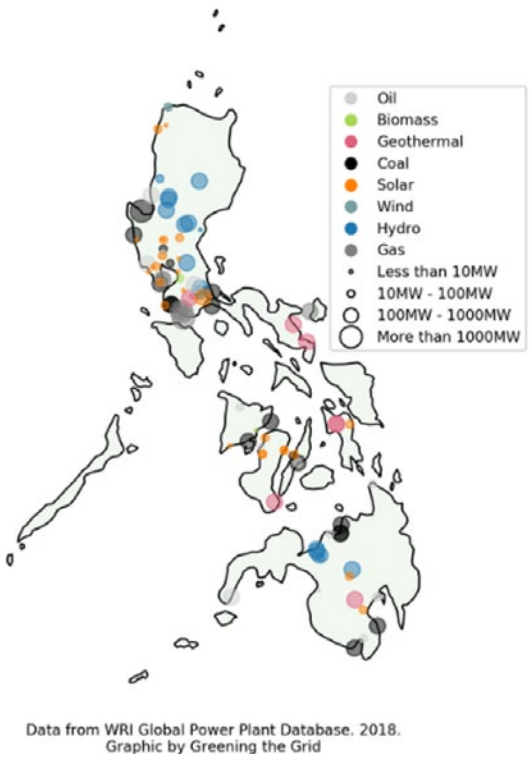
FIGURE 18.1 FORECAST INSTALLED GENERATING CAPACITY, REFERENCE (LEFT) AND CLEAN ENERGY SCENARIO (RIGHT)



Source: DOE.[5]

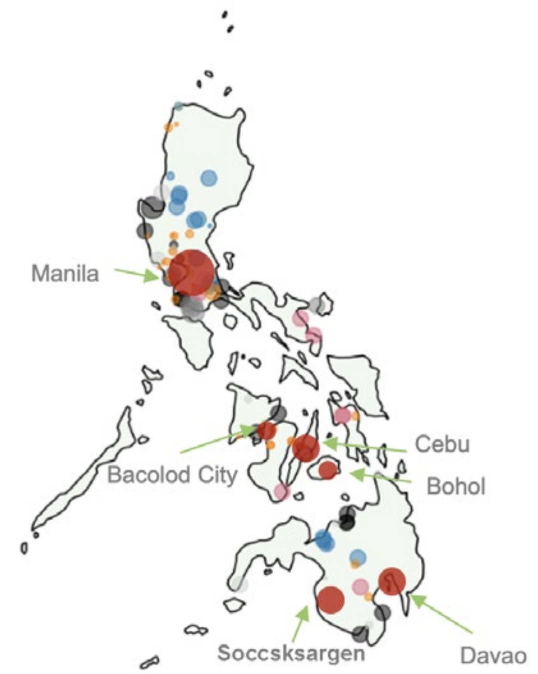
Figure 18.2 shows a map of power generation by type which is generally located north and south of Manila; central and western Visayas; and northern, central, and southern Mindanao. Figure 18.3 shows the same map with main load centers where most of the demand for this power generation comes from. In Luzon, the main load center is Manila which provides nearly 50 percent of demand. In Visayas, the main load centers are found in the southwest in Cebu, Bacalod City, and Bohol. Of these, Cebu is the largest also taking nearly 50 percent of the power supply for the region. In Mindanao, the main load centers are in the south at Davao and Soccsksargen which similarly make up around 50 percent of the power demand.

FIGURE 18.2 POWER PLANTS



Source: Greening the Grid.[86]

FIGURE 18.3 KEY LOAD CENTERS



Source: Greening the Grid.[88]

18.4 CONSIDERATIONS WITH INCREASED DEPLOYMENT OF VARIABLE RENEWABLE ENERGY

Key considerations are

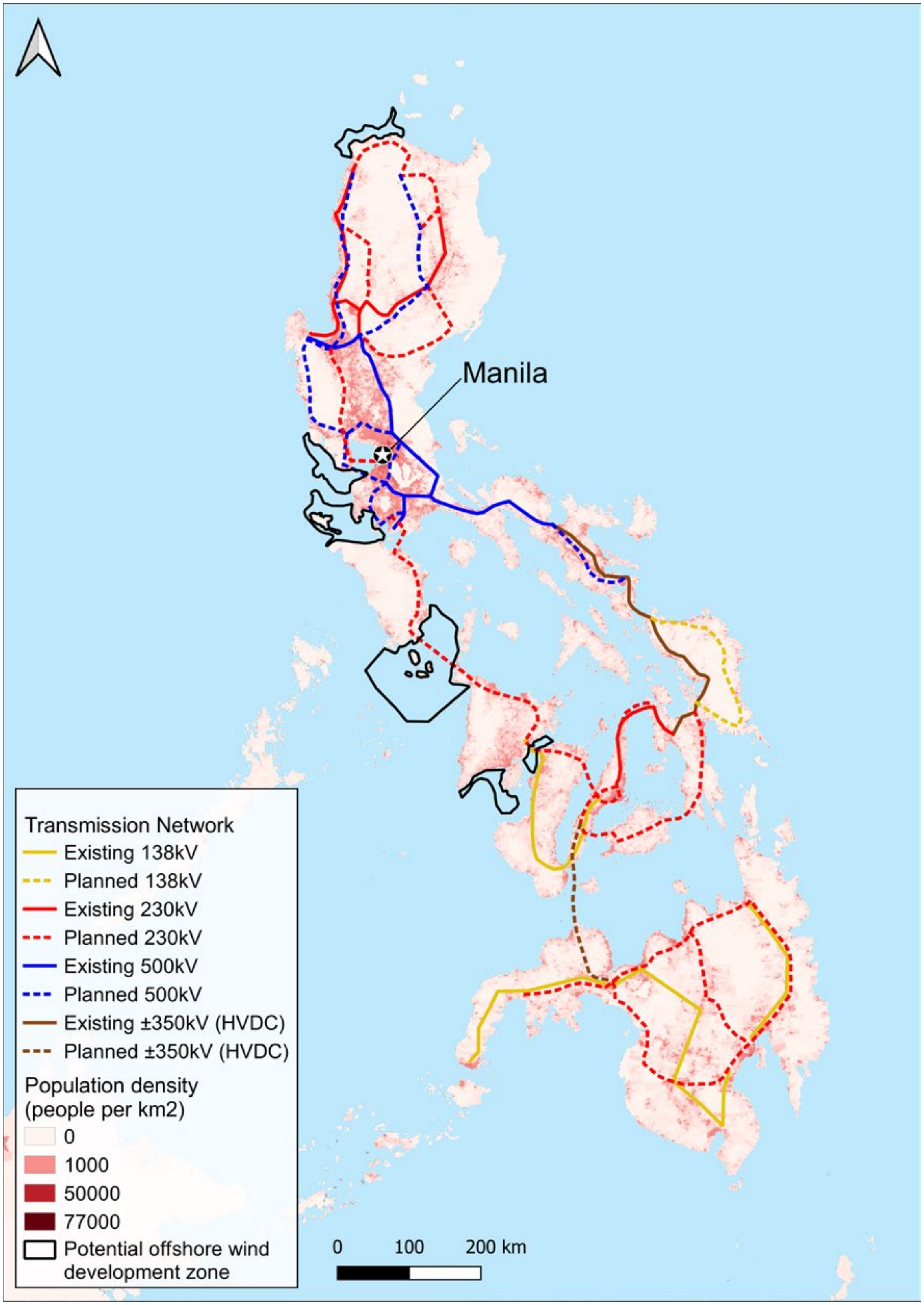
- **The need for substations and transmission upgrades.** Inevitably as new power plants are brought online, new substations and transmission line upgrades will be needed. New transmission infrastructure will also be required to bring RE (including OSW) and other power from areas of remote generation.
- **Inclusion of suitable energy storage systems.** The inclusion of suitable and strategically placed energy storage systems in the transmission network will enhance the grid robustness and resilience to handle increased RE sources through peak load management, frequency regulation, and reduction of the required spinning reserves.
- **Grid harmonics.** A wind turbine contains variable-speed generator technology with a power converter, which emits harmonic currents. In addition, they impact the resonance frequencies of the grid due to the presence of large amounts of capacitance in subsea cables and capacitor banks. At the point of connection, harmonic compensation must be considered.
- **Reactive compensation.** Connection of OSW by onshore and subsea cables also gives rise to voltage increases during energization and low load situations, needing reactive compensation locally through static var compensators (SVCs).

- **Dispatching and wind farm control.** Increased wind capacity warrants the use of forecasting systems to estimate the variable infeed. Dispatch procedures and reserve calculations may need to be changed to consider variations in output. Where the amount of conventional generation is low, system stability can be a major issue. A mix of wind farm control and other control technologies are therefore required to ensure security of supply which could otherwise lead to periods of wind farm curtailment which if uncompensated will lead to an unacceptable investment risk.
- **System frequency and inertia.** Following the disconnection of a generator, the frequency of the transmission and distribution system will decrease. The frequency drop and rate of change depends on the contribution to system inertia from the offline generator, duration of fault, available inertia from other generators on the network and network demand. With the increased penetration of wind, the overall system inertia will decrease. To balance this, however, inertial and frequency response can also be provided by wind power by balancing controls between maximizing performance, reliability, and stability provision to the transmission network. OSW farms can control active power to respond to grid frequency events to assist in overall grid stability. A similar performance to conventional generators can be achieved by using controlled inertial response technology. Wind farm capabilities can also provide flexibility to transmission and distribution network operations through inertial response which can assist system reliability. In many power systems, ancillary service markets have been developed and provide incentives toward developing technologies which provide support to transmission system reliability.
- **Technologies to address grid challenges.** The Renewable Readiness Assessment Report for the Philippines provides specific recommendations for grid evaluation studies to be undertaken to determine the impact of variable RE system power flows on the stability of the existing network from which it is expected that there may be grid stability, voltage, congestion, or overloading concerns within the transmission network. The studies will help identifying the needs to implement grid upgrading works with the aim to identify and implement technologies to address challenges for the longer-term Philippines transmission network.

18.5 CURRENT TRANSMISSION NETWORK UPGRADE PLANS

The planned upgrading works to 2030 are shown in Figure 18.4 and we consider the opportunity to connect early large OSW projects in the OSW development zones to this upgraded system. It is assumed that the upgrades to absorb 20 GW of OSW by 2040 and 40 GW by 2050 will require up to 15 years of design, planning, and construction and therefore this process needs to be started in the early 2020s. Environmental and permitting requirements have the potential to delay such a large-scale program.

FIGURE 18.4 NATIONAL TRANSMISSION OUTLOOK

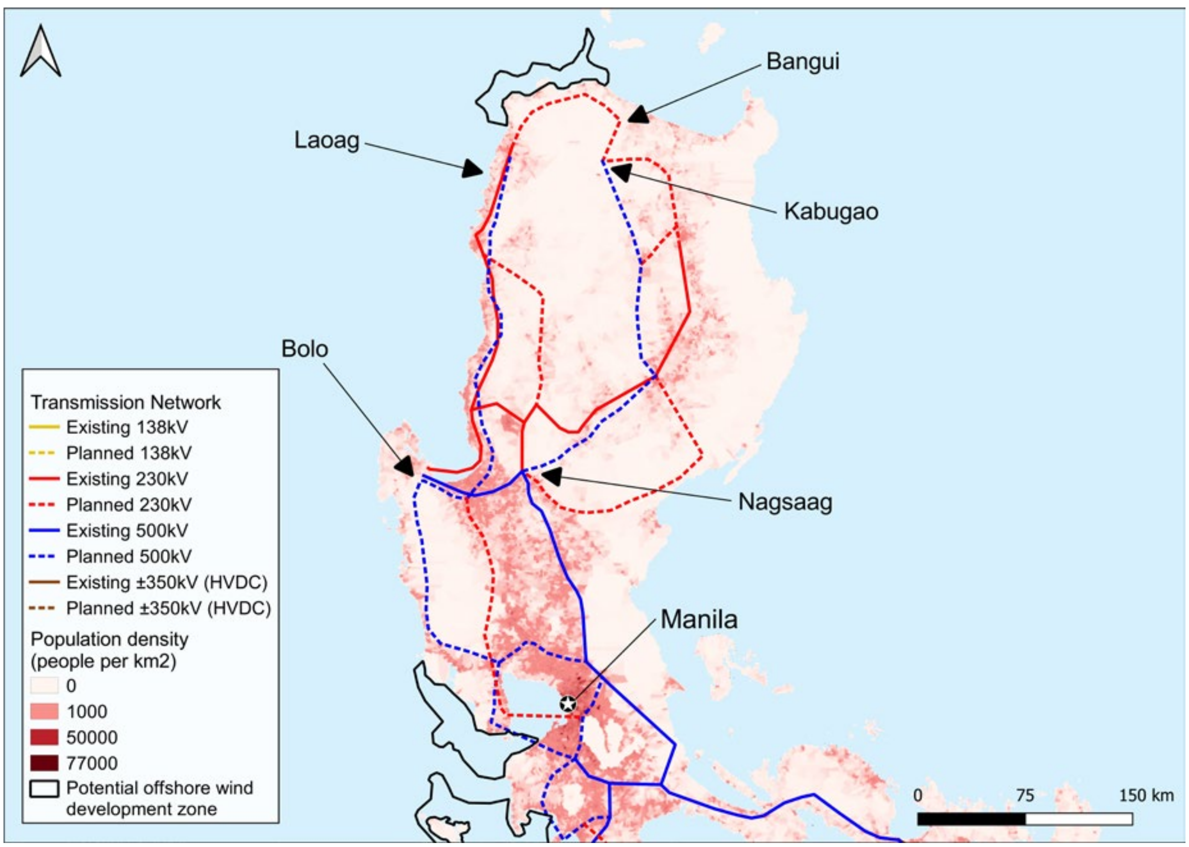


Source: NGCP.

North Luzon

The existing and proposed transmission grid upgrades for the North Luzon area are shown in Figure 18.5. The implementation of the Bolo to Laoag 500 kVAC transmission line addresses the entry of the proposed coal, hydro, and wind power generating plants in the northeast of Luzon and is scheduled for completion by 2028. It is understood that, once complete, 800 MW of additional power may be accommodated at the new Laoag 500 kV substation which is planned for completion by 2028, though some of this capacity has already been allocated. However, this substation is still located far from the potential OSW development zone at the northern tip of Luzon. It is therefore recommended that the 500 kVAC line be extended further north to Bangui and around the northern tip of Luzon in a loop with potential to connect with the 500 kVAC line which is currently being implemented between Kabugao and Nagsaag forming a connection with Bolo, to form a ring around the northern end of Luzon Island. It is noted that this will likely pass through several Key Biodiversity Areas including the Apayao Lowland Forest and the Kalbario Natural Park and therefore suitable measures will need to be taken to mitigate the impacts from these works in these regions. This will require careful route selection, and robust environmental and social impact assessment (ESIA) for each route.

FIGURE 18.5 NORTH LUZON TRANSMISSION OUTLOOK



Source: NGCP.

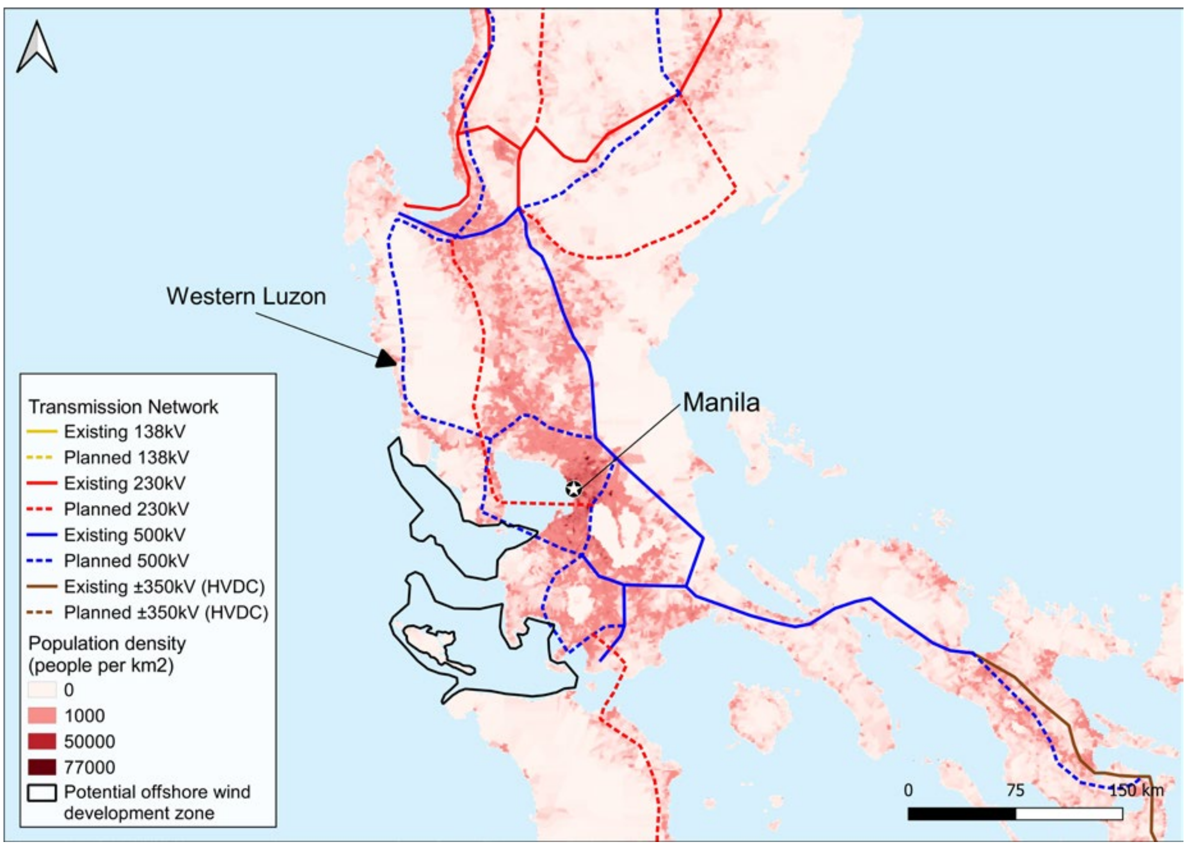
The Tuguegarao-Lal-lo 230 kVAC transmission line is also currently being implemented to improve the quality and reliability of supply in the area. This is targeted for completion by 2024 and will form part of the planned development of the Northern Luzon 230 kVAC Loop. The Northern Luzon project will involve the development of three 230 kVAC substations in Bangui, Sanchez Mira, and Pudtol and upgrading of the 230 kVAC lines. It is doubtful, however, that the 230 kVAC lines will be able to accommodate an additional 800 MW of power from OSW and therefore the 500 kVAC lines will most likely be needed to provide the required capacity.

Southwest Luzon

The existing and proposed transmission grid upgrades for the Southwest Luzon area are shown in Figure 18.6. The southwest part of Luzon has three planned transmission lines.

The West Luzon backbone will connect the existing 500 kVAC at Paliwag in Batangas to the planned substation at Bolo which will connect to the northern section of Luzon through the Bolo to Laoag transmission line.

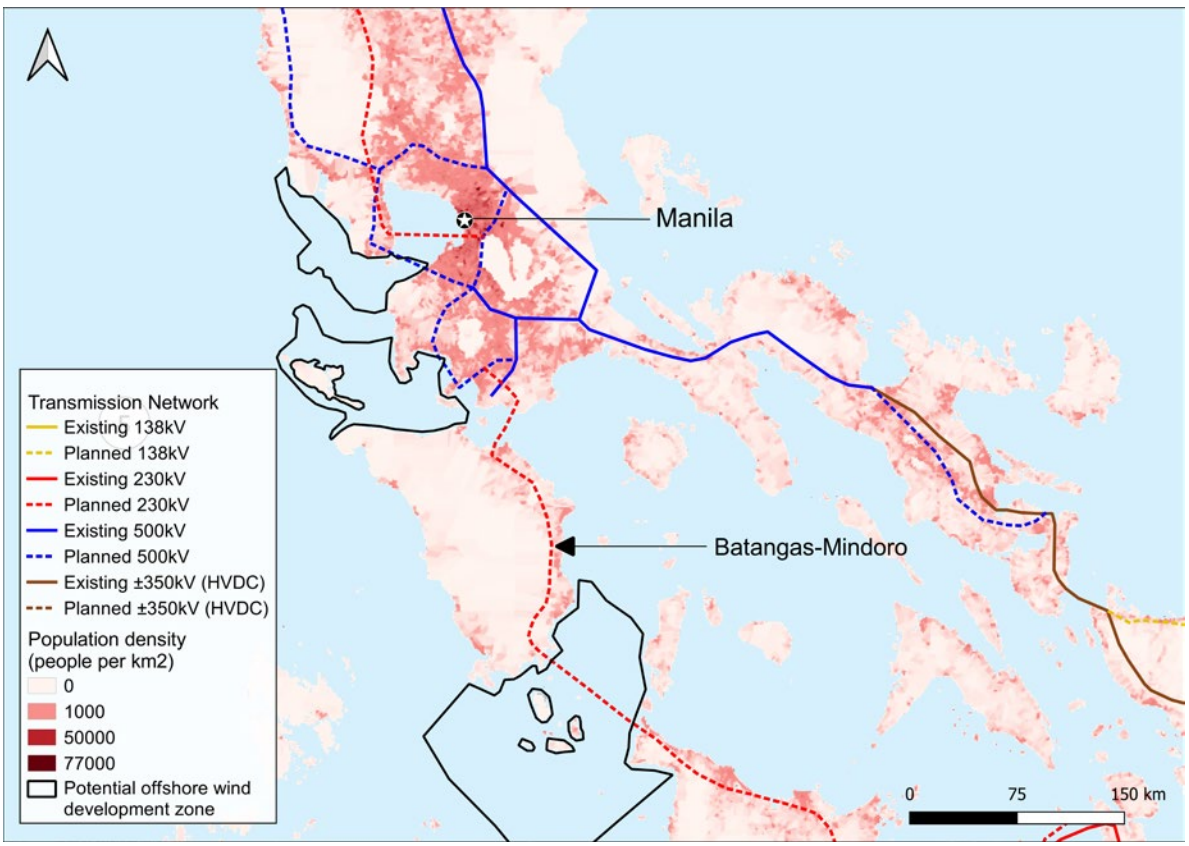
FIGURE 18.6 SOUTHWEST LUZON TRANSMISSION OUTLOOK



Source: NGCP.

The Batangas-Mindanao interconnection to Mindoro Island from the existing Luzon transmission network will provide access to RE projects on Mindoro Island as shown in Figure 18.7. This is currently planned to be a 230 kVAC transmission line and will be unlikely to have sufficient capacity to take an additional 800 MW of power from an OSW project. The nearest connection point in the Luzon transmission network for the planned interconnection projects is the Pinamukan 500 kV substation while Calapan would serve as the interconnection point on Mindoro Island. The future establishment of a 230 kVAC line through Mindoro Island to Panay Island is also planned. Considering the location of good OSW resources both to the north and south of Mindoro Island, we recommend increasing the planned upgrade of the Bantagas-Mindanao interconnection to a 500 kVAC transmission line. It is noted that this will potentially pass through several Key Biodiversity Areas including the Naujan Lake National Park and therefore suitable measures will need to be taken to mitigate the impacts from these works in these regions. This will require careful route selection, and robust ESIA for each route.

FIGURE 18.7 BATANGAS-MINDORO INTERCONNECTION



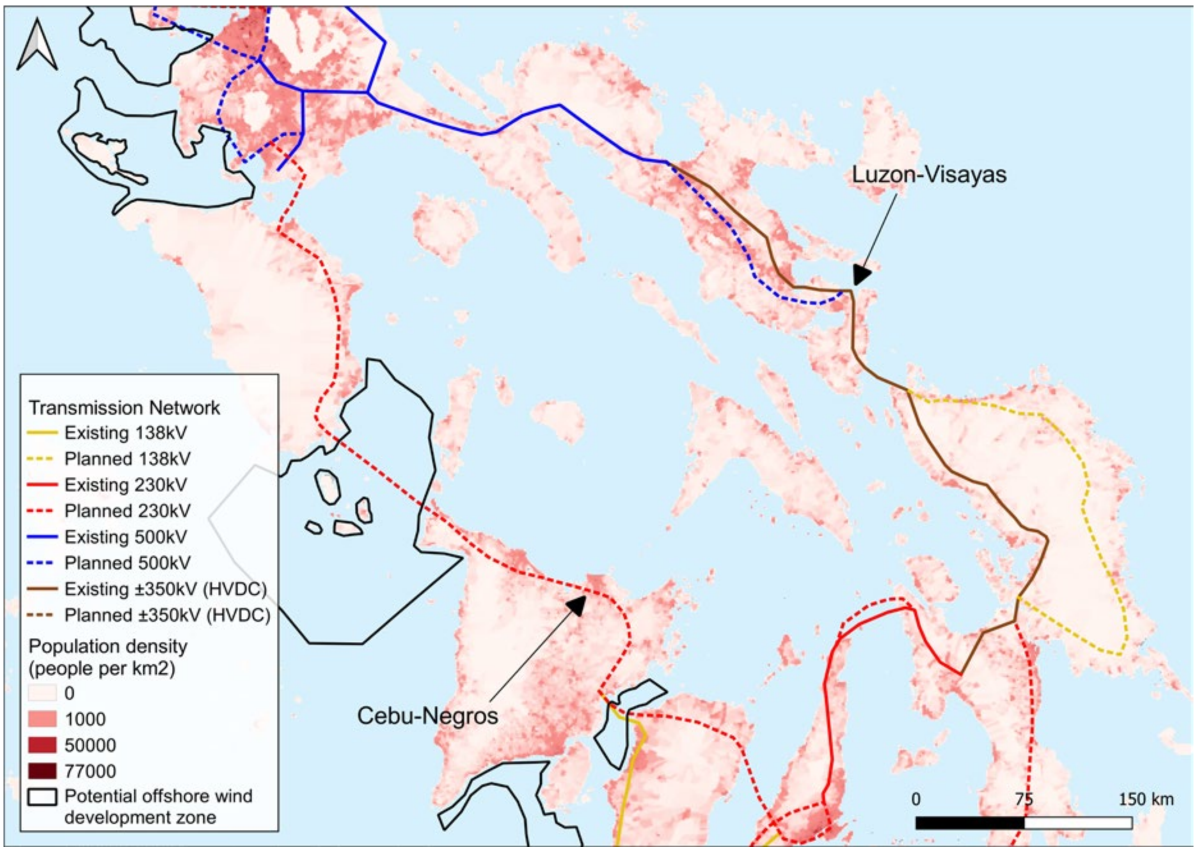
Source: NGCP.

Southeast Luzon

The existing and proposed transmission grid upgrades for the Southeast Luzon area are shown in Figure 18.8. On the southeastern side of Luzon, it is understood that the existing 500 kVAC transmission backbone from Naga to Yabos currently only operates at 230 kVAC due to limitations in the energizing capacity of the Naga substation located in the Bicol Region. This therefore serves as a termination point for the HVDC interconnection system that allows the exchange of power for up to

440 MW between Luzon and Visayas. To provide additional capacity in the system to accommodate OSW developments on the east side of Luzon (where a WESC has already been awarded and others have been applied for), it will be necessary to upgrade the Naga Substation to 500 kVAC to connect with the existing 500 kVAC substation at Pinamukan in Batangas and hence to provide a direct transmission path to Manila. This is not essential for the identified potential OSW development zones. Any development will require careful route selection, and robust ESIA for each route.

FIGURE 18.8 SOUTHEAST LUZON TRANSMISSION LINE AND LUZON-VISAYAS INTERCONNECTION OUTLOOK

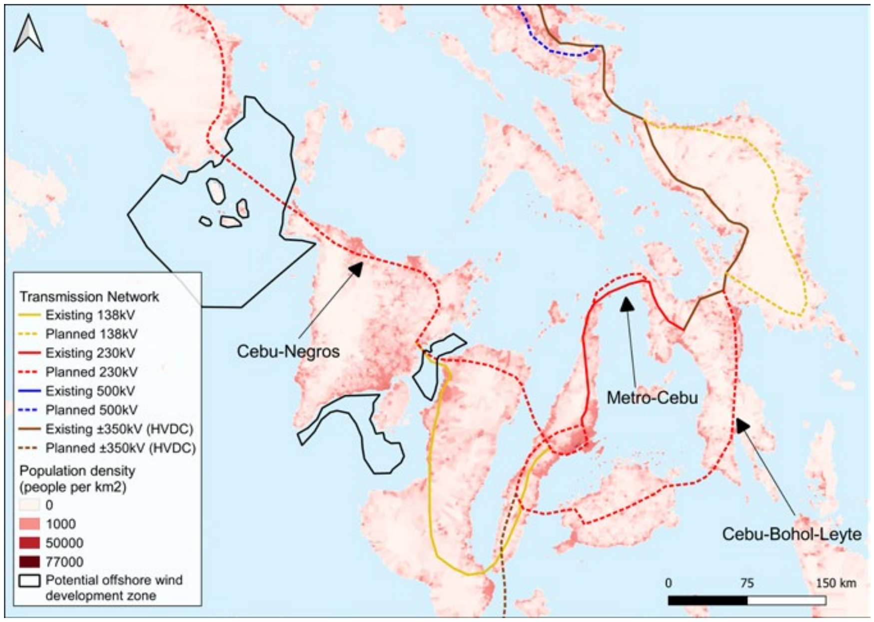


Source: NGCP.

Visayas

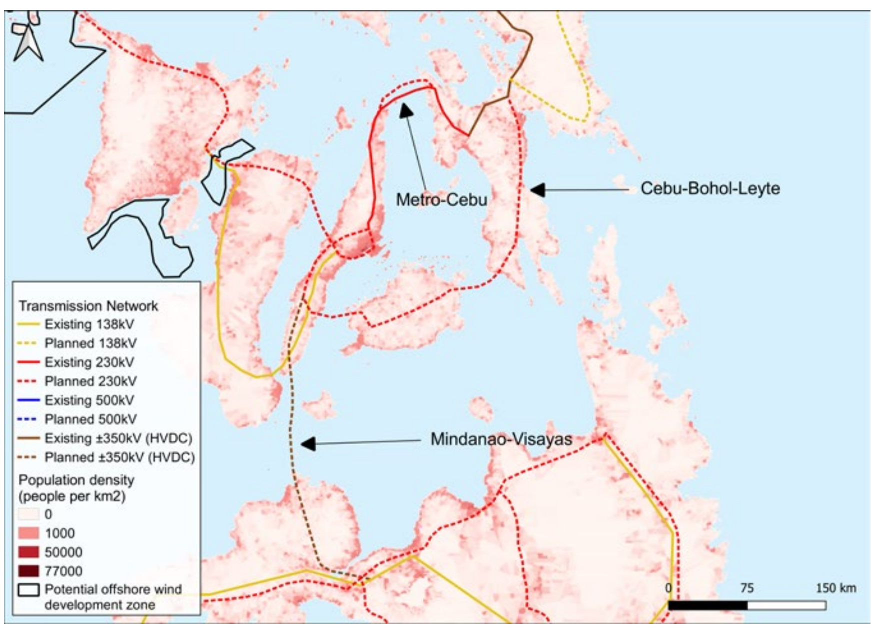
The existing and proposed transmission grid upgrades for the Visayas area are shown in Figure 18.9. The reinforcement of the existing 138 kV Cebu-Negros-Panay submarine cable interconnection is planned along with the development of a 230 kV transmission backbone from Cebu up to Panay Island (Cebu-Negros-Panay 230kV Backbone) and the development of the new 230 kV backbone up to Bohol to accommodate planned conventional and RE projects. Much of the increased power generation in this area, including from planned OSW projects, is proposed to be sent to Cebu as shown in Figure 18.10 where the demand is significant. Currently two lines are planned for the Cebu-Negros-Panay submarine cable interconnection which is planned to be completed in 2025 with further plans to increase to four by 2035.

FIGURE 18.9 CENTRAL VISAYAS TRANSMISSION OUTLOOK



Source: NGCP.

FIGURE 18.10 SOUTH VISAYAS TRANSMISSION OUTLOOK



Source: NGCP.

Mindanao

Mindanao operates at a maximum voltage of 230 kV. It is proposed that two 230kV interconnectors may be enabled to provide further demand for power produced from the new OSW farms, but it is unlikely that OSW projects will be built in the area due to poor wind resource.

18.6 FUTURE NETWORK REQUIREMENTS AND IMPLEMENTATION PROCESS

General Process for Deciding Future Transmission Network Development Requirement Upgrades

The future requirements for transmission networks are decided by the DOE and documented in the TDP. This plan is based on the list of Private Sector Initiated Power Projects (PSIPP), which classifies each project into one of three different categories:

- Committed projects have a WESC and are at the development and commercial stage and have reached FID.
- Indicative projects are similar to committed projects but have not reached FID.
- Prospective projects are at the pre-development stage and therefore not included in the official list for the PSIPP but have clearance to apply for service contracts and undertake a system impact study. These projects are monitored regularly by the DOE and their Electric Power Industry Management Bureau (EPIMB) for potential inclusion on the DOE's Power Development Plan (PDP) list.

At present, most committed projects on the list comprise coal, natural gas, solar, hydro, geothermal, and biomass. As discussed in Section 15, the application for WESC is through the DOE following the procedures given in the Renewable Energy Act of 2008, RA 9513 and details the general, legal, technical, and financial aspects for the proposed project. It also includes the letter of intent (LOI), map coordinates, facility capacity, and the primary equipment to be energized.

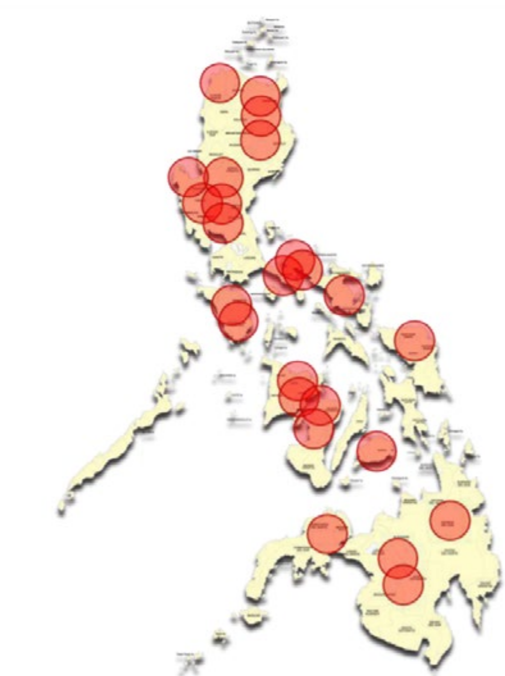
Integration of Renewables into the Future Transmission Network Development Plans

Due to the mismatch in timing between the development of most RE projects and the establishment of the associated grid connection, as described above, the transmission upgrade process for renewables is undertaken through separate policy initiatives in accordance with the DOE Circular No. 2018-09-0027 - Establishment and Development of Competitive Renewable Energy Zones.[88] The CREZ transmission planning process applies to all potential RE projects that are constrained by the lack of existing available transmission network capacity.[89] This is achieved by identifying areas for RE development and encouraging transmission upgrades to the areas with highest potential at optimal cost which is undertaken through the Philippine Energy Plan (PEP), PDP,TDP, and the NREP. The intention is to proactively provide transmission to the most productive areas to encourage development of renewables which can often be established much quicker than the transmission connections. There are four steps to the CREZ planning process:

1. Resource assessments to identify suitable renewable energy zones
2. Candidate selection for CREZ based on resource potential, technical, geographical, environmental, and social considerations
3. Transmission options development including system impact studies for the proposed CREZ areas
4. Final transmission plan designation for the CREZ.

Currently proposed projects that are included as CREZ developments are summarized in Figure 18.11. It is noted that many of these CREZ developments are close to the potential OSW development zones and hence there is already consideration of transmission network upgrade works in these areas.

FIGURE 18.11 COMPETITIVE RENEWABLE ENERGY ZONES CREZs IN 2020



Source: DOE.

To identify and characterize a set of implementable TDPs to deliver the power from the CREZ developments, a three-stage modelling process is followed:

1. The DOE is initially responsible for the preparation of the Capacity Expansion Model to determine the optimal transmission network build-out plan to meet demand and reserve requirements.
2. The findings from this will be fed into the Spreadsheet Optimization Tool, which is the responsibility of NGCP, to further optimize the capacities by consideration of practical issues.

The results will then be provided back to the DOE to undertake the Production Cost Model to optimize the planned dispatch schedules and generation units to physical and economic constraints of the system.

One of three outcomes are typically expected from this process[xxiv]:

1. Implementation without the need for transmission network reinforcement aside from what is already stated in TDP 2020–2040[90];
2. Implementation with general transmission network expansion; or
3. Implementation with specific transmission network expansion.

xxiv The need for additional transmission reinforcement depends on the existing or planned capacity of the proximate transmission network in the selected area and proposed power generation output of the proposed renewable energy source. A general expansion will entail directly increasing the capacity of the transmission network while specific expansion will entail upgrading of selected facilities only.

An 800 MW wind farm would likely require general expansion of the transmission network in the majority of the potential areas as it will be challenging to accommodate such a high load input within the existing grid and planned upgrades stated in TDP 2020–2040.

18.7 GRID CONNECTION PROCESS

The Philippine Grid Code and Distribution Code establishes the basic rules, requirements, procedures, and standards that govern the operation, maintenance, and development of the high-voltage backbone and distribution transmission systems in the Philippines.[91] The code identifies and recognizes the responsibilities and obligations of different functional groups, including

- Grid owner,
- System operator,
- Market operator,
- Distributers, and
- Users.

These functional groups must comply with all the provisions of the grid code. The grid code is intended to be used along with the Market Rules of the Wholesale Electricity Spot Market to ensure the safe, reliable, and efficient operation of the grid. The codes are enforced by the ERC, which may impose fines and penalties for violations of their provisions. The grid code was updated in 2016 to incorporate renewables and therefore covers the general principles for the electrical connection of intermittent supply sources to the transmission network. This is satisfactory for the case where the same transmission owner and operator manage the onshore and offshore network infrastructure and connections. For the scenario where separate offshore transmission network owners and operators exist, there will be a need to incorporate additional specific requirements for the grid entry point within the existing code. These would substantially reduce the risk of an outage or low power quality impact from large-scale power import to the Philippines Grid. There is therefore potentially a need to update the code further, depending on the proposed ownership and operation responsibilities for the respective transmission networks to include the incorporation of up to 20 GW of OSW renewable power by 2040.

In addressing future needs, the Philippines needs to ensure that the processes for issuing grid connections to projects is capable of handling increased volumes and applications in a fair, transparent, and timely manner. Grid connection for OSW in the Philippines' context means the connection of a system to the main transmission network operated and maintained by the NGCP.

A WESC covers two phases of activity:

1. *Pre-development stage (PDS).* The aim is to develop a detailed feasibility study, which will include a system impact study for the transmission network (endorsed by the DOE and undertaken by NGCP) and a distribution impact study (undertaken by the distribution utility). The detailed feasibility study aids in taking the decision to declare commerciality for the project, which will trigger conversion of the project to a development stage project upon confirmation by the DOE.

2. *Development and commercial stage (DCS).* This stage covers a number of steps, including grid connection agreements. As a committed project, the OSW project will be included in the TDP once FID is complete, and necessary transmission network upgrades will be proposed jointly between the DOE and NGCP. NGCP will be tasked with the delivery of the transmission network upgrade works which will be planned to meet the timeline for the proposed completion of the OSW project. This will be endorsed by the ERC. In assessing a potential RE project, or set of projects, it must be demonstrated that the proposed output meets a known demand, the grid remains stable and secure and that the investment costs and the resulting costs of electricity must be minimized. The projects that satisfy these requirements, as well as other statutory pre-construction requirements, will be issued a Certificate of Confirmation of Commerciality and are generally included on the DOE list which details the required grid reinforcement and the timing for each project.

Unfortunately, this situation causes a mismatch in schedules between the timeline for the OSW project construction, which takes around two years from FID, and the availability of the grid connection which can take more than five years. The need for advanced grid development is therefore crucial for the development of OSW. Without a guaranteed network connection, it is not possible for developers to reach FID. The principle of CREZ has been developed to address this issue by planning and developing the transmission network ahead of time in the most promising areas as described in the sections below.

Grid connection agreement

The OSW developer must secure a Grid Connection Agreement (GCA) which allows connection of the plant to the grid from relevant authorities. In case the power plant is to be directly connected to the transmission network, the OSW developer will secure this with NGCP. The GCA is a legally binding contract which will be formed between the NGCP and the developer for which penalties will apply both ways in the event either party is delayed. These penalties will normally be linked to the penalties that the developer will be exposed to with the transmission network operator under their PPA.

Service agreements

Upon successful completion of the development and commercial stage, a service agreement must be applied for, which consists of

- A Transmission Service Agreement (TSA) and
- A Metering Service Agreement (MSA).

In the Philippines, NGCP is mandated to provide revenue meters to all RE installations. A metering agreement therefore must be signed between the RE developer and NGCP.

Following completion of the works, electrical inspections will be conducted by a LGU and the DOE, respectively. The Certificate of Final Electrical Inspection will be granted after successful inspection by the LGU and the Confirmation of Electromechanical Completion will be secured after the inspection by the DOE. The cost of inspection by the DOE will be borne by the developer.

The list of sub-steps for each procedure to secure a grid connection has been presented in Table 18.1.

TABLE 18.1 SUMMARY OF THE GRID CONNECTION PROCESS

<table>
<tr><th>Step</th><th>Sub-Step</th><th>Required Documents</th></tr>
<tr><td>Grid Connection Agreement (GCA)</td><td>• Submission of GCA application adheres to
1. Open Access Transmission Service (OATS)
2. The Philippines grid code
3. Open access procedures
• Reviewed by NGCP
• Notification to pay a fee for a grid impact study or contract a consultant and pay a review fee to NGCP</td><td>• LOI from developer
• Clearance from the DOE
• Plant description and technical data
• Connection scheme and target completion date
• Feasibility study
• Signed offer of service
• Grid impact study</td></tr>
<tr><td>Transmission Service Agreement (TSA)</td><td>• Submission of TSA application
• Construction of facilities at the connection point approved by NGCP
• Conducting of pre-energization activities together with the grid customer
• Issuance of a readiness to connect
• Conducting of online testing witnessed by the NGCP
• Final connection validation by NGCP
• Signing of the TSA</td><td>• Letter of application
• Load approval from the ERC
• GCA
• Issuance of certificate of technical requirements:
1. District Office clearance
2. Metering Services Group clearance
3. Maintenance and Testing Division clearance
4. Payment of security deposit</td></tr>
<tr><td>Metering Service Agreement (MSA)</td><td>• Same steps as TSA application</td><td>• Same documents required as TSA application</td></tr>
<tr><td>LGU's Certificate of Final Electrical Inspection</td><td>• Electrical safety inspection conducted by the respective LGU
• Testing and verification of the electrical wiring before the installation of meters</td><td>• None</td></tr>
<tr><td>DOE Confirmation of Electromechanical Completion</td><td>• Informing the DOE of the completion
• Site visit by the DOE within 15 days; the project must have reached 80% completion based on approved plan
• Issuance of confirmation/denial in 15 days</td><td>• Letter informing the DOE that the project has reached electromechanical completion</td></tr>
</table>

18.8 DISCUSSION

It is apparent that significant upgrades are required to strengthen the transmission and distribution network over the next 30 years to accommodate the increase in both the demand and supply of power which will come from a variety of sources. The current plans from NGCP are the first step in the upgrade but a much bigger vision will be required for 2050 to support the energy transition. It is recognized that the focus of the power demand is presently at Manila and Cebu with ambitions to open new transmission corridors through Mindoro and throughout Visayas. While this is encouraging, there is a concern that with these current plans, increasing RE penetrations could have an adverse impact on the operation and stability of the transmission network. Therefore, detailed power systems analyses focusing on the reliability and resilience of these plans are recommended through power flow simulations to determine the most appropriate grid reinforcement measures to be applied.

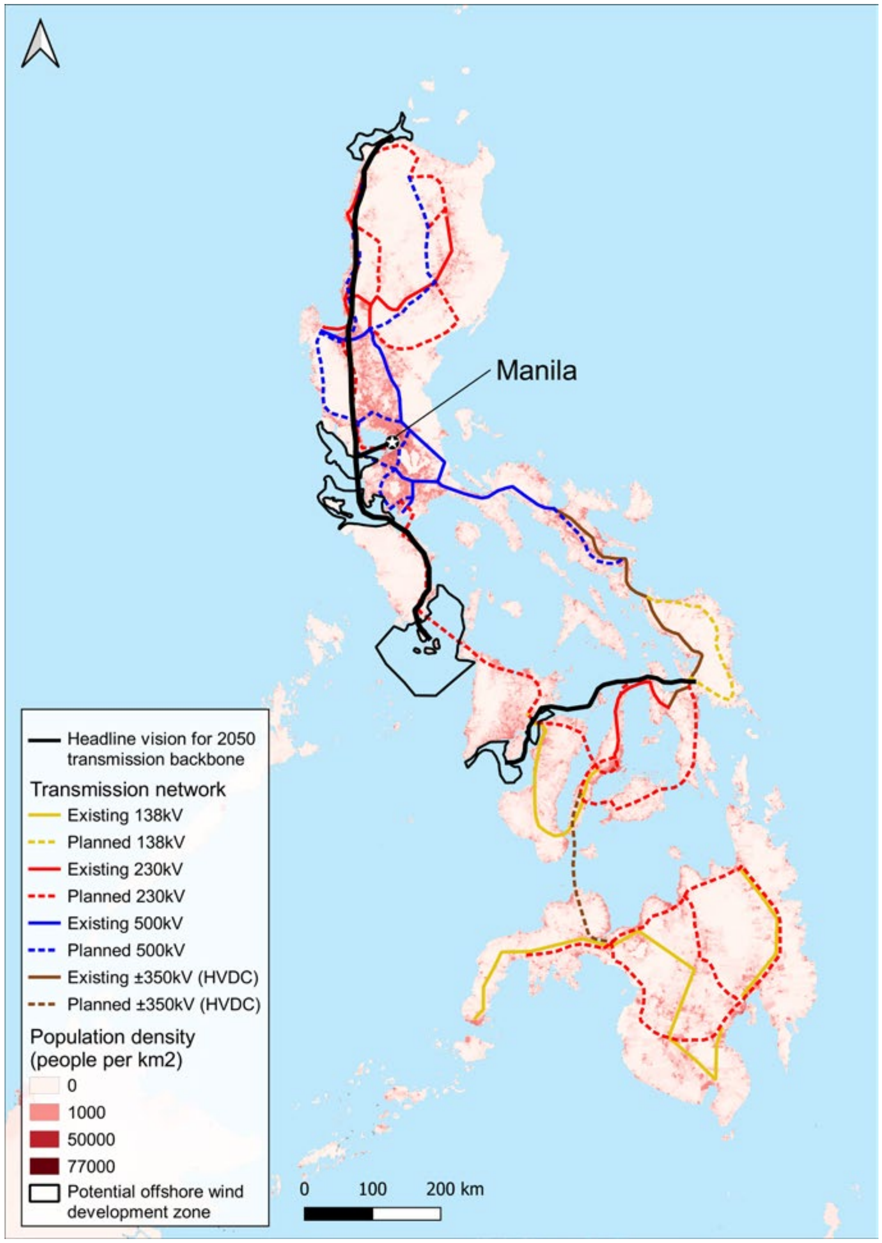
On inspection of the currently proposed transmission upgrades, additional measures that may be required to enable 20 GW output from the potential OSW development zones by 2040 include the following:

- Creating a strong backbone in Northern Luzon to bring power from the Northwest Luzon potential OSW development zone, suitable for floating projects, into the Manila area, an extension to the existing proposed 500 kVAC upgrading works.
- Creating a link between Manila and the Southern Mindoro potential OSW development zone.
- Significant stretches of these lines could be subsea, offering increased build-out speed at reduced cost. These lines would need to be supplemented with suitable energy storage systems to regulate the transmission network frequency and provide better peak load management.

In this manner, significant capacity can be developed close to these links, allowing growth of the OSW market in the potential OSW development zones, as well as extensive electrification of domestic and commercial activities along the routes.

Although this would potentially meet most OSW needs up to 2040, further strengthening will be needed beyond this, especially in the areas where a sizable proportion of the OSW developments could be located, such as the southern end of Mindoro. This vision is shown in Figure 18.12. The grid reinforcements shown will provide increased capacity in parts of the grid that projects the OSW Development Zones will likely connect to.

FIGURE 18.12 TRANSMISSION VISION IN THE HIGH GROWTH SCENARIO FOR 2050



Source: NGCP.

The financing and timing of these transmission network upgrades will be critical as they can typically take more than ten years to plan, design, and implement but will allow the connection of OSW projects to offshore hubs for the high growth scenario and is therefore a key recommendation for this study.

Substantial investment will be required to build such transmission system upgrades. This can be undertaken using conventional loans from the international market, although the sums are potentially prohibitive. One commonly used mechanism to facilitate large transmission system upgrades that lessen the investment burden on governments is a build-own-operate-transfer (BOOT) model. Under this model, a private business is mandated by the government to finance, construct, build, and operate the transmission infrastructure. The investment is recovered by levying a fee to the government.

This approach could allow the Philippines to undertake an accelerated program of transmission build without public investment.

Note that throughout our analysis, we have included the cost of a 40-kilometer export system, connecting each OSW project to the transmission network, via either

- Offshore substation, 20-kilometer subsea export cable and 20-kilometer of onshore export cable, to an onshore substation or
- Offshore substation, 40-kilometer subsea cable, to an offshore hub, likely serving multiple OSW projects.

The cost of the above plus the wind farm specific switchgear and auxiliary equipment in the substation that is located on the transmission network are included, but not the onward cost of transmission network upgrades, that will contribute to the ongoing electrification of the Philippines.

18.9 RECOMMENDATIONS

Based on this analysis, it is recommended that the DOE

- Publishes the 2050 vision for a nationwide electricity transmission network for a decarbonized energy system, with milestone plans for 2030 and 2040 and consideration of finance. This is a topic much wider than OSW, considering all electricity, transport, and heat.
- Incorporates OSW development zones fully into CREZ processes and TDP processes.
- Along with the Department of Environment and Natural Resources (DENR), NGCP, and Transmission Corporation (TransCo) undertake regional and countrywide power systems studies to understand the potential impacts of large volume OSW on the future transmission network, building in system robustness through the integration of suitable energy storage systems and other stabilization measures. In undertaking this process, careful consideration should be given to the route selection, with robust ESIA analysis in line with GIIP and lenders' requirements undertaken for each potential route, feeding relevant information into MSP activities.
- Works with NGCP and TransCo to update TDP delivery, approval processes, and grid management practices to reflect the move to more supply from RE sources.
- With WBG support, considers low-cost solutions for the investment and procurement of transmission system upgrades including BOOT models to encourage private businesses to finance, construct, build, and operate the transmission infrastructure, and the use of concessional finance.
- Ensures clarity and efficiency for projects in securing grid connections, including point-to-point applications and compensation for delayed grid connection availability once a GCA is signed.
- With ERC, consider amendments to the existing Philippines Grid Code and Distribution Codes to cater to the significant increase in renewable power from OSW and other variable forms of RE generation.

19. PORT INFRASTRUCTURE

19.1 PURPOSE

In this work package, we assess the Philippines port infrastructure capability for OSW. We focus mainly on floating OSW supply chain needs and on ports to support coastal manufacturing and construction, in line with the scenarios presented in Section 2. Typically, the requirements for floating OSW activities exceed those for fixed when the fabrication and assembly of floating foundations with turbines are completed in the same location as turbine marshalling. Road, rail, and other infrastructure requirements around ports depend on port use. In general terms, although there is limited infrastructure, we do not see significant issues relating to onshore logistics for the construction and types of manufacturing that we anticipate within the next 10 to 20 years.

Ports to support operation of the project over the 25 or more years of generation typically have much lower requirements and any investment is easier to justify over the long operating life of an OSW project.

It is preferable for floating projects that the ports can accommodate floating foundation manufacture, preassembly of turbines, and final assembly of turbines and floating foundations in one location or where these activities can be completed in ports near each other. The current consensus from industry is for floating projects to be installed with the turbine and floating foundation fully assembled and towed to site using tugs. It is therefore preferable that transit distances are as low as possible to reduce the length of weather window required during towing operations, conducted at relatively low speeds.

We understand that Central Luzon, Calabarzon, and Central Visayas have shipbuilding facilities that could provide suitable infrastructure for manufacture and preassembly, without significant upgrade cost.

We look at the Philippines port capabilities and gaps and provide recommendations on how best to address potential bottlenecks. This is important as good ports are critical for safe and efficient construction of OSW projects. This underpins the work in Section 10 and Section 11 and informs other activities.

19.2 METHOD

We started by establishing port requirements for floating OSW by 2035. As the industry continues to develop quickly, a 15-year horizon for investment in ports is a reasonable time scale.

We then used team and stakeholder knowledge to assess existing ports in locations relevant to OSW, categorizing ports as

- Suitable with little or minor upgrades (cost less than US$5 million);
- Suitable with moderate upgrades (cost between US$5 million and US$50 million); or

- Suitable only with major upgrades (cost greater than US$50 million).

We shared this assessment with key developers and other stakeholders and gathered feedback and additional data.

We have focused on ports that meet (or are close to meeting) requirements but recognize that there are also smaller ports with potential for expansion that could also in time be suitable for OSW activity, especially on the basis of a long-term government strategic vision for OSW.

Environmental and social aspects have only been considered at a headline level and would need to be incorporated fully during more detailed option appraisal in the future.

Port assessment criteria

The criteria used to assess both construction and manufacturing ports are defined in this section and summarized in Table 19.1. Construction ports must accommodate the delivery and storage of a large volume of wind farm components. These ports must be capable of facilitating full or partial assembly of turbines and foundations prior to load out and transport to the wind farm site.

For fixed projects, the load out of components normally occurs in batches of four or more turbines or foundations at a time, depending on the capacity of the vessel used.

A construction port for floating projects can vary in terms of application. In some instances, fabricated floating foundations can be transferred to a marshalling port for assembly with turbines, while under another approach fabrication of floating foundations is completed in the same location as turbine marshalling.

The main difference between construction and manufacturing port requirements is space. Manufacturing facilities require large areas for warehouses and storage space for components before onward transportation. In some cases, manufacturing ports may facilitate construction activities through co-location or clustering. The feasibility of this solution depends on storage space and quayside access constraints, ensuring each process can continue simultaneously without hindrance.

Construction port requirements

Fixed projects

For fixed projects, construction ports will often receive components in batches which are temporarily stored before load-out for installation. The minimum storage space for a construction and marshalling port is specified as 13 ha for 400 MW build-out per year. For sites with greater weather restrictions or for larger-scale projects, up to 30 ha is required.

Quay length requirement is between 250 and 300 meters, which will accommodate up to two midsize jack-up installation vessels or one next-generation installation vessel such as Jan De Nul's 'Voltaire' or DEME's 'Orion'. These vessels have drafts ranging between 8 and 10 meters and minimal channel depths have been specified based on this. Port channels must be wide enough for vessels with beams ranging between 45 and 60 meters with overhead clearances of 140 meters to allow for the vertical shipment of turbine towers.

Quaysides need bearing capacities between 20 and 30 metric tons/m^2 for load-out to adjacent vessels while storage areas need a capacity of at least 10 metric tons/m^2.

Quayside cranes can be used to lift turbine components and foundations in port areas. Suitable cranes have capacities between 500 and 1,000 metric tons for turbine components and between 1,400 and 2,200 metric tons for medium to large monopiles. We acknowledge that lifting is often completed by installation vessels or temporary land-based cranes during load-out, so the importance of this criteria has been reduced in our analysis. Self-propelled modular transports (SPMT) facilitate the onshore transport of cargo between storage and quayside areas. Mobile and crawler cranes are also used for materials handing but as ports can temporarily hire this equipment, weightings were applied to reduce the significance of this criteria.

Ports also need workshop areas, personnel facilities, and good onshore transport links, which are included in Table 19.1 under 'other facilities'.

Floating projects

Foundations for floating projects generally require more space due to their size and general preference to fabricate steel tubulars or sections at the same location where the final assembly of foundations is completed. This would require a minimum of 20 ha. For a port to facilitate floating foundation manufacture and assembly with turbines at the same location, a minimum of 40 ha is required across a site. In practice, the chosen method will depend on factors such as floating foundation type, port facilities, and proximity to other ports that might be used for marshalling of turbines separately. An additional port location can also be used for the marshalling for anchors, which are installed separately and in advance of floating foundations. The space requirement for anchor marshalling is around 5 ha.

A key feature of floating foundations is the draft of the floating substructure, with the leading concepts such as tension-leg platform (TLP) and semi-submersible expected to require a minimum water depth at the quay of around 10 meters. Anchorage areas are also required to store completed floating foundations and a minimum requirement of around 13 ha is estimated for these purposes.

A quay length or dry dock boundary similar to ports for fixed projects is required to allow for the assembly of a single turbine with a floating foundation, which could extend to around 500 meters if two assembly processes are completed simultaneously. Quayside or dry dock bearing capacities of between 20 and 30 metric tons/m^2 will be required for the assembly process. A minimum of 10 metric tons/m^2 is also required in storage areas. Quayside cranes are required for the assembly of turbine components with floating foundations. Suitable cranes have capacities between 500 and 1,000 metric tons.

Manufacturing port requirements

The typical minimum space needed at a turbine tower or blade manufacturing facility is around 20 ha, while nacelle manufacturing tends to require less space at between 6 and 10 ha. We anticipate blades or nacelles will not be manufactured locally in the Philippines, rather being supplied from elsewhere in East Asia, at least up until the early to mid-2030s.

Suppliers of floating foundations often have transferable expertise from the manufacture of jackets, ship hulls, and other large-scale marine structures. The minimum space required for a floating foundation manufacturing yard to serve 400 MW per year is approximately 20 ha which can be either on land or in dry dock areas. This increases to 40 ha to deliver up to 1 GW annually. This considers only partially assembled floating foundations such as hull sections and tubulars which would be shipped elsewhere for full assembly.

Offshore substations tend to be large but are often fabricated and then assembled as single or two units at a time and require space similar to a nacelle manufacturing facility. Substations use less serial manufacturing processes, so are more like oil and gas fabrications. Local manufacture of substations is likely.

TABLE 19.1 CRITERIA FOR ASSESSING THE PHILIPPINES' PORT CAPABILITIES

Port criteria	Value
Fixed project port storage space (ha)	13–30 (marshalling and preassembly) 20–30 (manufacturing)
Floating project port storage space (ha) (incorporating available dry dock space)	20–40 (foundation manufacturing) 40–60 (foundation manufacturing and assembly with turbines)
Storage area bearing capacity (metric tons/m²)	10
Quay length (meter)	250–300
Quayside bearing capacity (metric tons/m²)	20–30
Quayside depth (meter)	10
Channel depth (meter)	10
Channel width (meter)	45–60
Wet storage area for completed floating foundations (ha)	13
Overhead clearance (meter)	140
Crane capacity for fixed foundations (metric tons)*	1,400–2,200
Other facilities	Workshops, skilled workforce, personnel facilities, road and rail links

Note: *Lifting capacities may be provided by mobile or vessel cranes during load-out.

19.3 RESULTS

The Philippines has an expansive coastline of over 36,000 kilometers, owing largely to over 7,600 islands that make up the country. There are approximately 436 ports in the Philippines that are owned and operated by private and public entities. The Philippines Ports Authority is responsible for most of the ports in the country, managing 88 public and 238 private ports. The World Economic Forum ranked the efficiency of the Philippines seaport services as 88 out of 141 countries, while road connectivity was ranked 125, suggesting that access to ports by road can be a restriction in many locations.

With the majority of suitable wind resource and potential OSW sites located in the central and northern regions of the Philippines, including off Cagayan, Central Luzon, Western Visayas, and Mindoro, this has helped focus the search for suitable ports. Notable major ports in these regions are Iloilo, Batangas, Manila, and Subic. With the Philippines being a significant trading nation, the majority of the large-scale ports are congested with land space mainly reserved for cargo, container traffic, and roll-on-roll-off (RORO) ferries. This is especially the case for the capital Manila, where the port areas are heavily utilized with container traffic, with little or no unused space for heavy fabrication or marshalling. A given OSW project needs a large amount of space for only one to two years, which tends not to be compatible with an active cargo port having a constant flow of goods. It is the same in Iloilo, Batangas, and Subic; however, heavy fabrication sites and shipbuilding facilities exist within 100 kilometers of these locations, which present the greatest potential for OSW development activities. Batangas Bay and Subic Bay are two potential hotspots with a strong legacy in shipbuilding and heavy fabrication of marine structures.

Elsewhere there are many smaller multipurpose ports distributed throughout the country with land areas ranging between 3 and 5 ha. These sites have not been considered in the review due to 5 ha being insufficient for full construction support. It is likely that several of these facilities could provide storage and load-out of anchors for floating foundations or safe havens for vessels to shelter from adverse weather during installation of floating turbines.

Location of potential OSW suppliers

There are companies in the Philippines that will depend on reliable and accessible port infrastructure to supply the OSW industry. While there is limited immediate expertise in OSW in the Philippines, there are several entities with transferable knowledge that could play a part in the development of OSW projects.

Atlantic, Gulf and Pacific Company (AG&P) of Manila owns and operates the Batangas Heavy Fabrication Yard which is profiled in this section. AG&P is predominantly a downstream liquified natural gas (LNG) supplier and has experience of fabricating heavy, large, and complex units such as process units, modules, and various structures for marine applications from their Batangas Yard. AG&P has been identified as a potential supplier for towers, foundations, and offshore substations due to its transferable skills and marine expertise.

Keppel owns and operates two large yards in Batangas and Subic, both of which are profiled in this section. These locations are used for shipbuilding and repair but have good potential for heavy fabrication such as floating or fixed foundations. Keppel has a strong track record in the fabrication of offshore substations in other countries and could leverage this expertise to provide input to OSW in the Philippines.

EEI is one of the leading construction companies in the Philippines and has a steel fabrication shop located in Bauan, Batangas. EEI has the capability to fabricate and erect structures and assemblies for industrial installations and infrastructure projects. It has a strong track record in pressure silos, drums, and intricate steel structures. It has also utilized the Keppel Batangas Yard for large-scale fabrication projects. EEI has the potential to transfer this expertise for the fabrication of towers, foundations, and substation topsides.

Bauer Foundations is a subsidiary of Bauer Spezialtiefbau and has its Philippines headquarters in Manila. Bauer is mainly focused on ground piles and anchors for buildings in the Philippines although the parent organization has a renewables arm, based in the UK. This division provides marine solutions division for designing and installing steel foundation piles in all offshore environments and would likely make use of its position in the Philippines to provide these services as required. Bauer could use one of the yards in Western Luzon to fabricate and load out foundations for fixed projects. Its expertise in floating foundations is limited but it could likely make a transition into this area based on its legacy in marine expertise.

Ports likely to be used most for offshore wind

We have identified seven potential ports, driven mainly by the requirements for floating projects as these present the predominant long-term opportunity in the Philippines. A summary is provided in Table 19.9. A map of the port locations is provided in Figure 19.8.

Our assessment has generally identified that many of these ports have the space for manufacturing as well as construction. At this stage, we have not assessed port availability and interest in OSW—key next considerations for project developers. This activity could be left to industry or the government could play a role.

Port of Batangas Yard

The Port of Batangas is one of the major ports in the Calabarzon region and is seen as a less congested alternative to Manila. Batangas is mainly focused on international container traffic and domestic RORO activities, which are located toward the right side of the port basin in Figure 19.1. There is a significant amount of open storage space as shown by the amber region in Figure 19.1, which is approximated at 23 ha.

For floating projects, space constraints would limit the port to either smaller-scale floating foundation manufacture or assembling turbines with completed foundations after wet towing from another fabrication port. The port is in Batangas Bay, which provides natural shelter, and there is sufficient space to moor floating foundation assemblies surrounding the port.

The available space is potentially suitable for marshalling of fixed foundations or turbines. The site could also be leveraged for fixed foundation, tower, or blade manufacturing.

The site could also be considered for a manufacturing facility for offshore substations. There could be an opportunity to explore the use of additional land space in the surrounding container port for marshalling and preassembly activities. The load-out quay would need to be shared with the container port for the transfer of components to and from installation vessels, while there could be an option to build a new quay neighboring the amber shaded area in Figure 19.1. The port has good cranage and welfare facilities. It has handled many heavy cargo deliveries separate from container traffic. Neighboring greenfield space could potentially be explored to expand landside storage areas, though this appears to support remnant wetland habitats. Table 19.2 provides headline port specifications.

FIGURE 19.1 PORT OF BATANGAS YARD

Source: Google Maps, BVG Associates.

TABLE 19.2 PORT OF BATANGAS YARD SPECIFICATIONS

Port criteria	Value
Storage space (ha)	23
Storage area bearing capacity (metric tons/m²)	5*
Quay length (meter)	660
Quayside bearing capacity (metric tons/m²)	5–10 (expected)
Quayside depth (meter)	8–10
Channel depth (meter)	8–20
Channel width (meter)	420
Wet storage areas (ha)	>13
Overhead clearance (meter)	Unrestricted
Cranage	Good
Other facilities	Good

Keppel Batangas Shipyard

Keppel Batangas Shipyard is equipped to provide a broad range of offshore and marine services. The yard has completed extensive repair works for many vessel types including bulk carriers, dredgers, offshore support vessels, oil rigs, oil, and LNG tankers.

The facility has limited outdoor storage space of approximately 7 ha, although there are several covered halls that could provide facilities for fabrication of foundation sections. Additionally, a dry dock and a ship-lifting platform located to the right and bottom of the image in Figure 19.2 could be used for the load-out or launch of completed foundations. The facility could be considered for the fabrication of floating foundations while the quay length means that assembling of turbines with floating foundations could not be completed at this location. The neighboring Batangas Heavy Fabrication Yard could provide turbine marshalling and subsequent assembly with completed foundations. The site can also make use of the natural sheltering and expansive anchoring areas available to store completed floating foundations.

The site could also be considered for the fabrication and preassembly of fixed foundations by making use of the covered fabrication halls, although the quay would likely be able to accommodate only one vessel at any time, unless the quay alongside the ship-lifting platform can be used simultaneously, provided it has sufficient width and bearing capacity.

To the left of Figure 19.2, a disused coal terminal shaded in blue could also be leveraged to provide approximately 4.5 ha of space, though this is likely to be a modified habitat. The cranage and land bearing capacity is expected to be of a good standard. Table 19.3 provides headline port specifications.

FIGURE 19.2 KEPPEL BATANGAS SHIPYARD

Source: Google Maps, BVG Associates.

TABLE 19.3 KEPPEL BATANGAS SHIPYARD SPECIFICATIONS

Port criteria	Value
Storage space (ha)	7 (6 on land, 1 in dry dock) Possible 4.5 extension
Storage area bearing capacity (metric tons/m2)	10 (expected)
Quay length (meter)	133 (177 alongside ship-lifting platform)
Quayside bearing capacity (metric tons/m2)	10–20*
Quayside depth (meter)	8–10
Channel depth (meter)	20–25
Channel width (meter)	n.a.
Wet storage areas (ha)	>13
Overhead clearance (meter)	Unrestricted
Cranage	Good
Other facilities	Good

Batangas Heavy Fabrication Yard

Batangas Heavy Fabrication Yard is located next to the Keppel yard. AG&P of Manila owns and operates the 100 ha facility, which is used for heavy fabrication and assembly. The site benefits from direct, open water access and AG&P has a history of fabricating heavy, large, and complex units from this facility such as process units, modules, and various structures for marine applications. The yard has approximately 25 ha of open air storage space with several covered fabrication buildings.

The site has good potential for floating projects, either as a small-scale foundation fabrication space or as a turbine marshalling hub. The quayside could accommodate the assembly of one turbine and floating foundation at a time. The coordination of activities with the neighboring Keppel shipyard could be explored, with foundations built in the shipyard and the final assembly with the turbine completed at Batangas Heavy Fabrication Yard.

The yard could provide a suitable marshalling location for smaller fixed projects, offering sufficient space for fixed foundations or turbines.

This site could also be considered as a potential location for the manufacture of turbine components such as towers or nacelles and, based on its legacy of large-scale fabrication, could be considered for the fabrication of offshore substations. Usage of the 240-meter quay will likely require coordination with a neighboring car export facility. The yard will also benefit from the natural sheltering in Batangas Bay and make use of the widespread anchorage locations as required. Table 19.4 provides headline port specifications.

FIGURE 19.3 BATANGAS HEAVY FABRICATION YARD

Source: Google Maps, BVG Associates.

TABLE 19.4 BATANGAS HEAVY FABRICATION YARD SPECIFICATIONS

Port criteria	Value
Storage space (ha)	25
Storage area bearing capacity (metric tons/m^2)	5 (expected)
Quay length (meter)	240
Quayside bearing capacity (metric tons/m^2)	5–10*
Quayside depth (meter)	12–13
Channel depth (meter)	20–30
Channel width (meter)	n.a.
Wet storage areas (ha)	>13
Overhead clearance (meter)	Unrestricted
Cranage	Limited
Other facilities	Good

Hanjin Heavy Industries Shipyard

Keppel Subic Shipyard is located in the Subic Special Economic Zone and also in the Zambales Marine Protected Area Network. It has a strong history of ship repair, conversion, new build, offshore structures, and topside module fabrication. It boasts one of the largest dry docks in the Philippines spanning approximately 10 ha which includes a 1,500 metric ton gantry crane. The dry dock is adaptable and can be partially flooded to allow for the launch of completed structures or ship hulls, while others toward the back end of the dock remain dry.

The yard has a total expanse of approximately 21 ha, including the dry dock. The land adjacent to the dry dock is occupied by covered fabrication spaces meaning there is limited storage space at the facility. The longest quay has a length of 360 meters but is particularly narrow with a width of 30 meters. Subic Bay provides natural shelter from the open seas and many vessels anchor in this area.

The shipyard has the greatest potential for the fabrication of floating foundations, which would benefit from transferable expertise and dry dock infrastructure that will allow for the batch load out of completed floating foundations. With limited storage space elsewhere in the yard, completed floating foundations will likely need to be towed to a different port for assembling with the turbines. One potential option is to utilize the nearby Hanjin Heavy Industries (HHI) fabrication site, located approximately 6 kilometers south. Table 19.5 provides headline port specifications.

FIGURE 19.4 KEPPEL SUBIC SHIPYARD

Source: Google Maps, BVG Associates.

TABLE 19.5 KEPPEL SUBIC SHIPYARD SPECIFICATIONS

Port criteria	Value
Storage space (ha)	10 (10 dry docks)
Storage area bearing capacity (metric tons/m^2)	10 (expected)
Quay length (meter)	360
Quayside bearing capacity (metric tons/m^2)	10–20*
Quayside depth (meter)	8–10
Channel depth (meter)	10–15
Channel Width (meter)	n.a.
Wet storage areas (ha)	>13
Overhead Clearance (meter)	Unrestricted
Cranage	Good
Other facilities	Good

Hanjin Heavy Industries Shipyard - Subic

The HHI Shipyard in Subic spans over 180 ha of land in the Subic Freeport Zone and also in the Zambales Marine Protected Area Network. It was built on the location of a former US navy base after being handed over to the Philippine Government in 1992. The yard has built a variety of vessels including large container ships, LNG, and bulk carriers. It has two large dry docks of 10 and 7 ha and at its peak employed around 20,000 workers. The yard has suffered from the downturn in international shipping in recent years and sought court receivership in 2019. The yard is now inactive and seeking a new buyer. The Philippine Navy was considering the potential for a new base on this site while more recent reports have indicated that an American-Australian consortium is considering a takeover.

With infrastructure well suited to ship and hull fabrication, the dry docks would be an ideal location for the manufacture and load-out of floating foundations. The expansive fabrication halls could be used to serially fabricate floating foundation components. Besides the two dry dock spaces, approximately 20 ha of land could provide additional storage as shown on the bottom right of Figure 19.5. This could provide a location for turbine storage for eventual assembly with floating foundations in the dry dock. Subic Bay has expansive anchorage areas for the storage of completed floating foundations, which would be sufficiently sheltered in the enclosed basin.

The site could facilitate the fabrication of fixed foundations as required. The 20 ha of land could provide storage and preassembly of turbines or foundations for fixed projects. The nearby Keppel Shipyard could be used in tandem with this site, coordinating fabrication of marshalling activities as required. Table 19.6 provides headline port specifications.

FIGURE 19.5 HANJIN HEAVY INDUSTRIES SHIPYARD - SUBIC

Source: Google Maps, BVG Associates.

TABLE 19.6 HANJIN HEAVY INDUSTRIES SHIPYARD SPECIFICATIONS

Port criteria	Value
Storage space (ha)	38 (18 in dry docks)
Storage area bearing capacity (metric tons /m²)	10 (expected)
Quay length (meter)	550
Quayside bearing capacity (metric tons /m²)	10–20*
Quayside depth (meter)	10–20
Channel depth (meter)	20–30
Channel width (meter)	n.a.
Wet storage areas (ha)	>13
Overhead clearance (meter)	Unrestricted
Cranage	Good
Other facilities	Good

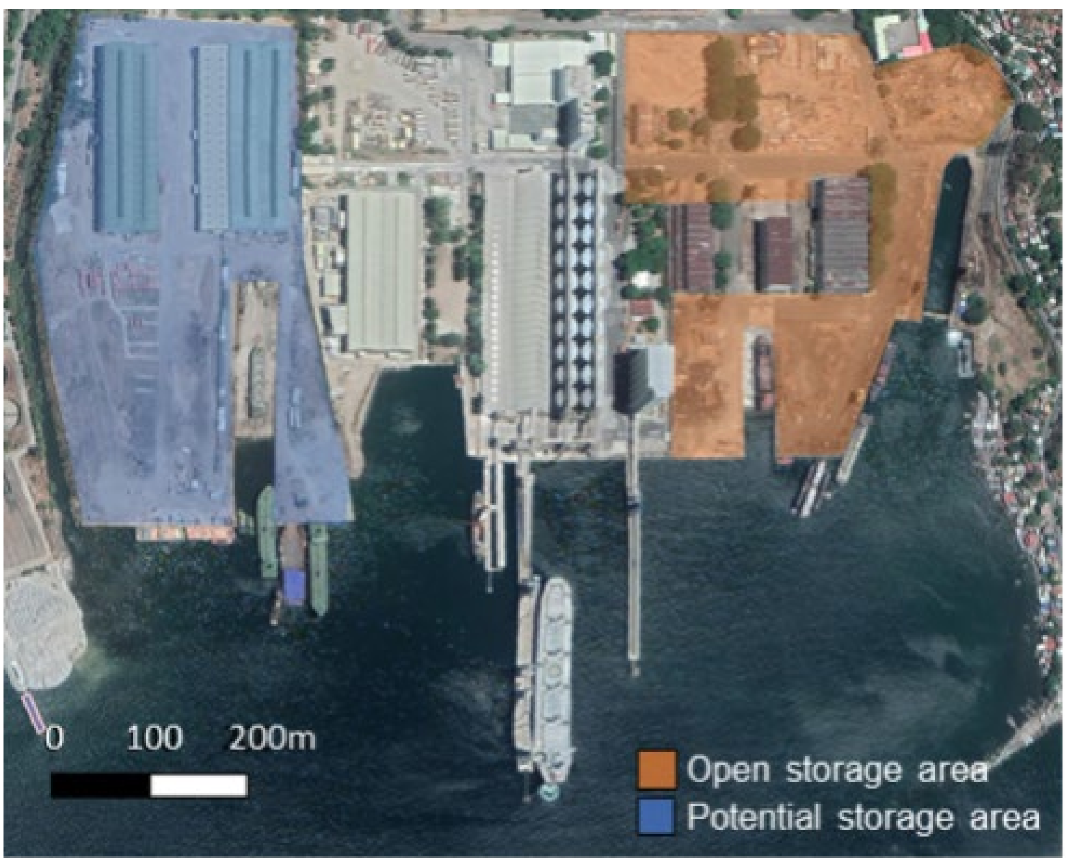
Herma Shipyard - Bataan

Herma Shipyard is based in the Bataan Freeport Zone and has built 11 new vessels since its inception in 2000. The shipyard is shown on the right half of Figure 19.6 and spans across 17 ha of land, 9 ha of which is available as open air storage. The shipyard has several covered fabrication spaces and offers one dry dock, a floating dry dock, and a slipway. The longest quay at Bataan is approximately 140 meters.

A nearby yard, as shown on the left of Figure 19.6, could provide an additional space of 12 ha and an additional slipway. If used in conjunction with the shipyard, these combined spaces could facilitate the fabrication of floating foundations. The dry dock could be used as a means to assemble floating foundation with turbines; however, the lack of large-scale cranage could be an issue and would require large mobile cranes to be brought onto the site. As the yard is located in the bay behind Bataan peninsula, it is expected that there will be sufficient anchorage areas to accommodate fully assembled floating foundations, though it will be relevant to consider the environmental impact of such activity.

If the site to the left of Figure 19.6 is made available, it could alternatively be used for nacelle or offshore substation manufacture. Table 19.7 provides port specifications.

FIGURE 19.6 HERMA SHIPYARD - BATAAN



Source: Google Maps, BVG Associates.

TABLE 19.7 HERMA SHIPYARD SPECIFICATIONS

Port criteria	Value
Storage space (ha)	9, with possible 12 ha extension
Storage area bearing capacity (metric tons/m^2)	5 (expected)
Quay length (meter)	140
Quayside bearing capacity (metric tons/m^2)	5–10*
Quayside depth (meter)	10–20
Channel depth (meter)	20–30
Channel width (meter)	n.a.
Wet storage areas (ha)	>13
Overhead clearance (meter)	Unrestricted
Cranage	Poor
Other facilities	Good

Tsuneishi Heavy Industries, Balamban - Cebu

The Tsuneishi Heavy Industries (THI) shipbuilding facility is the most southerly port considered in this review and was identified as the most feasible site to support potential developments in the Guimaras Strait. It is located in Tanon Strait Important Marine Mammal Area and Tañon Strait Protected Seascape, with remnant patches of mangrove to the north and south. THI is one of the leading medium-size shipbuilders in the world. Its site on the island of Cebu is large at almost 150 ha and has two shipbuilding berths with a maximum throughput of around 30 vessels per year. It has built many different types of vessels including bulk carriers, tankers, and car carriers.

As shown by the amber regions in Figure 19.7, around 30 ha of open air storage is available at the facility with around 5 ha of dry dock space. The site could therefore be used for various activities such as the fabrication of floating and fixed foundations while potentially using some of the open air storage space for the marshalling of turbines. Approximately 5 ha of additional space would be required to fabricate, make, and launch floating foundations on the site, which could be made available in the central area of the image in Figure 19.7. The dry docks could facilitate the assembly of floating foundations with turbines installed in the dock before float-out or at the 520-meter repair quay. The Tanon Strait where the THI facility is located could be used for the storage of floating foundations and would benefit from sheltering by the land mass, either side of the passage. As the facility is heavily active in ship repair and manufacture, early booking will be required to secure space for OSW development. Table 19.8 provides port specifications.

FIGURE 19.7 TSUNEISHI HEAVY INDUSTRIES - BALAMBAN - CEBU

Source: Google Maps, BVG Associates.

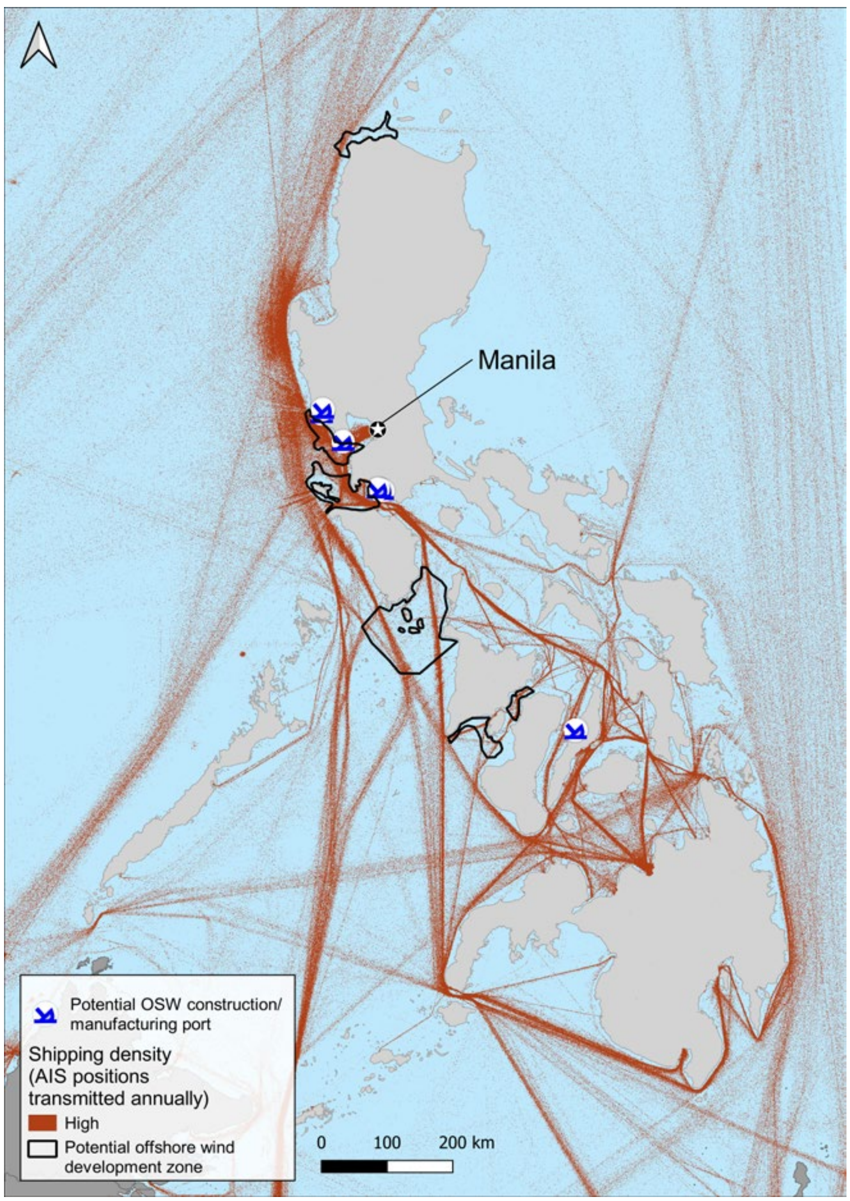
TABLE 19.8 TSUNEISHI HEAVY INDUSTRIES SPECIFICATIONS

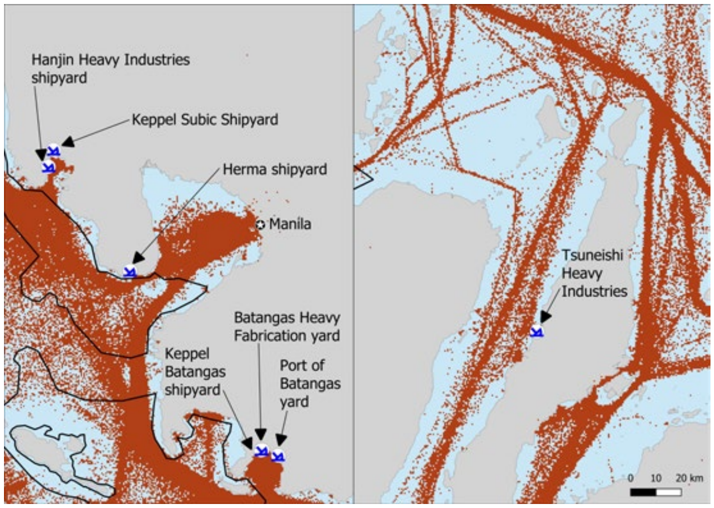
Port criteria	Value
Storage space (ha)	35 (30 land, 5 dry docks)
Storage area bearing capacity (metric tons/m²)	10 (expected)
Quay length (meter)	520
Quayside bearing capacity (metric tons/m²)	10–20*
Quayside depth (meter)	5–10
Channel depth (meter)	10–20
Channel width (meter)	n.a.
Wet storage areas (ha)	>13
Overhead clearance (meter)	Unrestricted
Cranage	Good
Other facilities	Good

19.4 DISCUSSION

Figure 19.8 shows that the ports with greatest potential are predominantly clustered on the west side of Central Luzon, except for the THI facility located in the Guimaras Strait. These are well placed to serve the proposed development surrounding Mindoro and Iloilo, although for other sites located in Northern Luzon and in Camarines, there is a lack of immediate port infrastructure. If the ports profiled in this section are to serve these locations, this could introduce prohibitively long vessel transit times. This is particularly problematic for floating projects as long weather windows will be required to safely tow turbine and floating foundation assemblies to these sites. If there is continued ambition to develop these sites, a case could be made to develop or upgrade an existing smaller port on the east coast in regions such as Aurora or Isabela.

FIGURE 19.8 OFFSHORE WIND MANUFACTURING AND CONSTRUCTION PORTS IN THE PHILIPPINES





Source: see Table 9.1.

Table 19.9 summarizes the assessment of ports, showing ports in indicative order of suitability for OSW construction and manufacturing.

TABLE 19.9 SUMMARY OF MANUFACTURING AND CONSTRUCTION PORTS FOR OFFSHORE WIND IN THE PHILIPPINES

Port	Suitability for construction	Suitability for manufacture	Comment
Tsuneishi Heavy Industries, Balamban - Cebu	Suitable with minor upgrades	Suitable with minor upgrades	• Ownership: Private • Location: Coastal (sheltered) • Capable of fabricating ships and large steel structures. • Good port facilities, quays, dry docks, cranage and space • Good potential for fabrication of floating foundations • Potential to accommodate floating foundation fabrication and assembly with turbines at same site with some additional space made available • Minor to moderate upgrades likely to bearing capacity of quayside • Moderate upgrades likely to quayside depth and width • Ongoing shipbuilding activity could affect availability of site.
Hanjin Heavy Industries Shipyard - Subic	Suitable with minor upgrades	Suitable with minor upgrades	• Ownership: Formerly private (now looking for a buyer). Austrian and American consortium considering purchase. Interest from Philippines Navy • Location: Coastal (sheltered) • Capable of fabricating very large structures, ships, and hulls • Good port facilities, quays, dry docks, and cranage • Good potential for fabrication of floating foundations • Good potential for direct storage of turbines and assembly of turbines with floating foundations in dry docks • Minor to moderate upgrades likely to bearing capacity of quayside.

Port	Suitability for construction	Suitability for manufacture	Comment
Keppel Subic Shipyard	Suitable with moderate upgrades	Suitable with minor to moderate upgrades	• Ownership: Private • Location: Coastal (sheltered) • Capable of fabricating large structures, ships, and hulls • Good port facilities, quays, dry docks, and cranage • Good potential for fabrication of floating foundations • Moderate upgrades to bearing capacity of quayside • Additional port space required for marshalling • Minor to moderate upgrades likely to bearing capacity of quayside • Minor upgrades required to channel depth.
Port of Batangas Yard	Suitable with minor to moderate upgrades	Suitable with moderate upgrades	• Ownership: Private • Location: Coastal (sheltered) • Good potential for manufacturing of turbine components or substations • Good potential for marshalling foundations or turbines for fixed projects • Suitable for small-scale floating foundation manufacture or as a turbine to floating foundation assembly location • Additional port space likely required for combined floating foundation manufacture and turbine assembly • Quay access could be restricted. An additional quay could be considered • Minor to moderate upgrades to bearing capacity of storage area • Moderate to major upgrades required to bearing capacity of quayside.
Batangas Heavy Fabrication Yard	Suitable with minor to moderate upgrades	Suitable with moderate upgrades	• Ownership: Private • Location: Coastal • Good potential for manufacturing of turbine components or substations • Additional port space likely required for large-scale floating foundation manufacturing • Good potential for fixed foundation and turbine marshalling • Potential to coordinate activities with neighboring Keppel yard • Minor upgrades to quayside depth • Minor to moderate upgrades to bearing capacity of storage area • Major moderate upgrades required to bearing capacity of quayside.

Port	Suitability for construction	Suitability for manufacture	Comment
Herma Shipyard - Bataan	Suitable with moderate upgrades	Suitable with moderate upgrades	• Ownership: Private • Location: Coastal (sheltered) • Potential to leverage neighboring yard space to enhance space availability and facilitate fabrication of floating foundations • Additional port space required for manufacturing and marshalling • Moderate upgrades to quay length • Moderate upgrades to bearing capacity of storage area • Major moderate upgrades required to bearing capacity of quayside • Improved cranage and handling solutions required.
Keppel Batangas Shipyard	Suitable with moderate upgrades	Suitable with moderate upgrades	• Ownership: Private • Location: Coastal (sheltered) • Limited outdoor space for storage and fabrication of floating foundations • Potential to extend into neighboring yard • Greater potential to use extension and neighboring Batangas Heavy Fabrication Yard • Moderate to major upgrades to quay length • Additional port space likely required for manufacturing of floating foundations • Extension of quayside required • Minor to moderate upgrades to bearing capacity of storage area • Major moderate upgrades required to bearing capacity of quayside.

The ports that have been profiled can sufficiently meet demand in both scenarios through the 2030s, based on the conservative assumption that approximately 20 ha of port space can accommodate for around 250 MW of annual development. Sufficiency also depends on other port uses and, in some cases, on ports working collaboratively and addressing the necessary upgrades required. Greater transparency of port specifications and capabilities is also needed to allow developers to identify the best site for fabrication or marshalling.

19.5 RECOMMENDATIONS

Based on this analysis, the following are recommended:

- Philippines Ports Authority encourages the publication of an OSW port prospectus, showing port capabilities against offshore physical wind requirements, and uses this to encourage dialogue and timely investment in relevant port facilities. This will involve engagement with independent government entities managing freeports.
- Philippines Ports Authority and the Department of Energy (DOE) work with ports to build a vision of how a pipeline of projects in the potential OSW development zones could be delivered in line with a strong government vision and to assess whether it is viable to establish any new port facilities. In undertaking this process, careful consideration should be given to environmental and

social considerations and robust environmental and social impact assessment (ESIA) analysis undertaken for any potential developments.

- Project developers and owners of suitable ports discuss early how the needs of OSW projects can be addressed, recognizing the need to share fabrication and assembly responsibilities in some cases.
- The DOE, the Department of Trade (DTI), National Economic and Development Authority (NEDA), Philippines Ports Authority, and relevant freeport zone authorities explore potential Philippines and inward investment to finance port upgrades or new facilities.

20. RISK AND BANKABILITY

20.1 PURPOSE

The purpose of this work package is to define project and market elements that affect the bankability of OSW projects in the Philippines. Our focus is the risks that have the potential for high commercial impact which may be perceived as a barrier by international or local investors.

We have considered a project developer's market risks associated with construction, commencement of commercial operations, and generation of revenue. Project risks relating to supply and technology are important, but not directly relevant to this roadmap. Broader financial market risks are addressed in Section 21. Risks to the government are covered in the SWOT analyses in Sections 3 and 4.

20.2 METHOD

Developing an OSW plant involves different risks and considerations to onshore wind and solar development. There are, however, benefits in taking elements of onshore renewables frameworks as a basis for the OSW frameworks, where relevant.

We therefore reviewed key aspects of the existing renewables market in the Philippines and considered current trends, such as the move toward an auction scheme from the current feed-in tariff (FIT) scheme and identified the risks that such a regime may create. We also looked at specific activities or commercial arrangements that have the greatest potential for impact to future cash flows of a project, for example, local grid capacity or skills level of local labor force for OSW.

Throughout, our guiding principle has been that risk should be placed where it can be best managed. There are some risks, such as higher than expected operating costs, which investors should bear as they are well placed to manage them. If risks that are outside of their control—such as regulatory or policy risks—are placed with investors, they will require an increased rate of return for bearing them. If risks exceed investors' limits, they will decide not to invest and to allocate their capital to other international investment opportunities. As a result, in some cases it can be more efficient for these risks to be placed on the government or directly on customers, as this will result in a lower cost to customers than the cost of paying investors to bear them.

Where we have found that the existing regime may allocate risks inappropriately in a way which may create a barrier to the rollout of OSW, we have suggested changes.

Each of the risks identified has been assigned a risk magnitude based on the following scale:

- *Red.* Significant financial risk to investors that is likely to stop investment happening, requiring mitigation from the government.
- *Amber.* Moderate financial risk to investors that will have significant cost or contractual implications and may need mitigation from the government.
- *Green.* Low-level financial risk not likely to stop investment, the government may consider mitigation.

20.3 RESULTS

The main financial risks for OSW in the Philippines are summarized in Table 20.1 and then discussed, alongside possible mitigations for the Government to consider.

TABLE 20.1 OFFSHORE WIND DEVELOPER INVESTMENT RISKS IN THE PHILIPPINES, WITH RED/AMBER/GREEN RATINGS ACCORDING TO THE PERCEIVED RISK MAGNITUDE

Risk	Description	Project phase	Risk magnitude RAG	Suggested government mitigation/measures
1. Pre-development risks	Complexity in pre-development applications and approval process could lead to planning and development delays.	Project development	R	Accelerate implementation of Energy Virtual One-Stop Shop (EVOSS). Set up service pledges for the EVOSS to encourage timely approvals and cooperation across government agencies.
2. Development risks	Complexity and limited capacity/efficiency of permitting process combined with limited local precedent of OSW deals could lead to delays and risk of changes in requirements.	Project development	R	Accelerate implementation of EVOSS. Set up service pledges for the EVOSS to encourage timely approvals and cooperation across government agencies.
3. Environmental and social risks	Potential environmental and social risks leading to permitting challenges, non-alignment, and construction delays.	Project development/ Construction	R	Need to take account of stakeholder views, follow GIIP, and understand the environmental and social impacts during development, construction and operational phases of projects.
4. Grid connection risks	A mismatch between the timing required by National Grid Corporation of the Philippines (NGCP) to obtain approval to develop the required grid infrastructure and the OSW developer's project timetable could lead to delay in grid connection being available.	Construction	R	More coordinated national planning around renewable generation capacity and transmission network capacity to enhance certainty of offtake. Compensation for delayed grid connection availability once Grid Connection Agreement (GCA) is signed.

Risk	Description	Project phase	Risk magnitude RAG	Suggested government mitigation/measures
5. Curtailment risks	Limitations in interconnection and grid management could result in the curtailment of wind power and affect project revenues.	Operation	R	Curtailment compensation (beyond a certain threshold). Under existing PPAs, curtailment of renewable energy (RE) generation due to transmission constraints is considered a force majeure event. Hence, no compensation entitlement. More coordinated national planning around renewable generation capacity and grid capacity to enhance certainty of offtake.
6. Foreign ownership limitations	40% foreign ownership cap will curb foreign investor appetite for Philippines OSW investment, especially later in project development, and this is likely to significantly slow project delivery.	Operation	R	Soften foreign ownership caps to allow foreign companies to hold majority shares in projects, enable more overseas involvement, and accelerate knowledge transfer to local companies.
7. Counterparty risks	No single or national offtaker for power supply agreements in the Philippines could lead to risk of variance in the creditworthiness of offtakers.	Operation	A	Explore establishing either a national offtaker or centralized coordinating body that can backstop offtaker obligations for multiple GW-scale projects.
8. Policy/ regulatory risks	A shift toward an auction scheme for RE instead of the existing FIT scheme could encourage developers to propose unsustainable tariffs.	Operation	A	Establishing a floor on pricing or requirement that bidders submit evidence of lender endorsement of proposed price may help alleviate this risk.
9. Contractual risks	Lack of a local and widely employed standardized PPA or offtake contract could lead to challenges in establishing market precedence.	Operation	A	Explore opportunity to develop a standard form PPA for adoption across OSW projects to accelerate market development. See *Key Factors* report for further discussion on this topic4.

Risk	Description	Project phase	Risk magnitude RAG	Suggested government mitigation/measures
10. Exchange rate risks	Adverse movements in Philippine peso relative to hard currencies including US dollar could lead to reduced foreign investor appetite.	Operation	G	The majority of foreign currency denominated cost is anticipated to be in upfront capital cost and can be managed through hedging. For foreign investors, long-term exposure to adverse movements in Philippine peso can be managed by including tariff indexation for foreign exchange rate variations into standard form PPA, under ERC mandate.[xxv]
11. Country risks	Local conditions stemming from the Philippines political, economic, and legal framework could affect the stability of earnings.	Project life cycle	A	Enforceability of contracts, both with the government and suppliers, is key, with access to international arbitration essential. Establishing either a national offtaker or centralized coordinating body that can backstop offtaker obligations can help manage this risk.

20.4 DISCUSSION

The Philippines deregulated its electricity market following the introduction of the Electric Power Industry Reform Act (EPIRA) of 2001. In 2008, the Philippines implemented the Renewable Energy Act aimed at promoting the development, utilization, and commercialization of RE resources.[70] A developer can pursue five major types of business models for on-grid RE:[92,93]

- FIT, which involves signing a long-term power purchase agreement (PPA) with the National Transmission Corporation (Transco) for the sale of the energy generated.
- Power supply agreements with a distribution utility, referring to bilateral agreements between RE developers and distribution companies.
- Power supply agreements with commercial bulk consumers, referring to bilateral agreements between RE developers and contestable consumers (end users with a monthly average peak demand of at least 750 kW over a 12-month period, and who are entitled to choose their electricity supplier). This is unlikely to be applicable to GW-scale OSW projects, due to demand from such consumers typically being only a few MW each.
- Green Energy Option Program (GEOP) that enables RE generators to sell directly to end users with at least 100 kW peak demand. As the largest end users of manufacturing plants, hotels, resorts, and shopping malls usually have a demand of only a few MW each, this option is not that viable for OSW project developers.
- Green Energy Auction Program (GEAP), a FIT being revised to apply the same concept as used in 2012 where the National Transmission Corporation will act as FIT fund administrator.

xxv While there is currently strong dollar liquidity in the Philippines coming from foreign remittances, it might be tough to get currency hedges for greater than five years. Based on recent public service agreements (PSAs), it seems that if a project relies heavily on dollar imports, indexation is generally allowed.

The regulatory regime in the Philippines is largely standardized across the different types of RE.[94]

Based on this market structure, key risks, challenges, and considerations for bankability of OSW developments in the Philippines context are as follows:

1. Pre-development risks: Complexity in pre-development applications and approval process could lead to planning and development delays. The wind energy service contract (WESC) provides a five-year provision for conducting wind energy resource exploration and obtaining various permits and licenses. A focus on accelerating implementation of the EVOSS Act will help streamline processing of government-led site planning and other necessary approvals through a 'single window' interface with approving authorities within the five-year timeframe. Establishing service pledges or key performance indicators (KPIs) for the EVOSS will encourage timely approvals and cooperation across government agencies.

2. Development risks: Given the nascent nature of the local OSW industry, limited local experience and capability may lead to delays in final investment decision (FID), equipment procurement, physical construction, and securing permits to begin commercial operation. The RE developer will need to obtain permits and certifications from the Department of Energy (DOE) when construction is near completion (typically around 80 percent) before the development can commence operation:
    - If using FIT, a Certificate of FIT Eligibility from the DOE and endorsed by ERC
    - If using a power supply agreement, ERC approval is required
    - Certificate of Compliance from ERC
    - A connection permit from NGCP.

    The need to secure various permits at a late stage may result in cost risks (capital costs increases) and uncertainty in the timing of the construction completion and commencement of revenue generation. The potential timing delays exposes the developer to the risk of unfunded costs during development and challenges fulfilling debt service obligations in line with the anticipated schedule.

    Similar to the pre-development phase, accelerating implementation of and establishing service pledges or KPIs for EVOSS will help streamline necessary approvals.

3. Environmental and social risks: The gap between domestic and international environmental and social impact assessment (ESIA) requirements could lead to delays in financing. If the proponent has obtained the Philippines' EIS but the lender requires the project to comply with International Finance Corporation's (IFC) Performance Standards, for example, significant extra study may be required to comply with the lender's requirement which can delay the construction phase. Environmental mitigation measures recommended by lenders (such as shutdown periods during times of bird migration) can potentially affect energy production, which translates to a reduction in the profitability of an OSW project.

4. Grid connection risks: A mismatch between the timing required by NGCP to obtain approval to develop required grid infrastructure and the OSW developer's project timetable could lead to delay in grid connection being available. For larger-scale projects, there is often a mismatch between the timing required by NGCP to obtain approval to develop the required grid infrastructure and the RE developer's project timetable.[96] Such events can affect cash flow and ability to meet debt service

obligations. More coordinated national planning around RE generation capacity and requirements for supporting grid capacity will improve investor confidence and certainty of offtake. At the project level, incorporating compensation provisions into GCAs is essential.

5. Curtailment risks: Limitations in interconnection and grid management may result in the curtailment of wind power and affect project revenues. In the Philippines, the transmission grid is owned by the government through Transco, but is managed and operated by the NGCP, a regulated private entity, through a concession agreement. With the growth in RE development in the country, there have been instances of curtailment of wind power resulting from grid-related technical issues. Implementing a reasonable level of curtailment compensation measures to reallocate this risk away from OSW developers (who are not in a position to control it) is essential.

6. Foreign ownership limitations: About 40 percent foreign ownership will curb foreign investor appetite for Philippines OSW investment. The DOE has outlined limitations on foreign ownership of RE projects in the implementing rules and regulations of the Renewable Energy Act, based on the Philippines constitution. It states that foreign ownership is restricted to 40 percent, but as the Act does not refer to generation, it is understood that there are no restrictions on that. Other laws also apply; however, for example, only Filipino citizens or corporations with capital stock owned by Filipino citizens are allowed to own land, so careful structuring of contracts will be needed.

   Softening foreign ownership caps to allow foreign investors to hold majority shares in projects would enable overseas involvement in the Philippines market, establish a track record of successful project delivery to de-risk the sector, and accelerate knowledge transfer to local companies. It is seen by many in industry as essential in facilitating the vast investment needed to deliver OSW projects, especially as projects move from pre-development (with low expenditure) to the later stage of development (higher expenditure, leading to FID). Routes to lifting the cap include the following:

   - Constitutional change
   - Issue of a DOE circular, in line with previous circulars covering biomass generation
   - Use of the changes to the Public Service Act that passed through the Senate in December 2021, liberalizing ownership of public utilities except for the distribution of electricity, the transmission of electricity, and water pipeline distribution and wastewater pipeline systems, airports, seaports, and public utility vehicles
   - Use of the Finance and Technical Assistance Agreement (FTAA) process, as suggested by one leading international OSW developer
   - Work-arounds recognizing state ownership of resources under the Regalian Doctrine, but allowing foreign ownership of energy extraction plant, while paying a fee to the state for rights to 'access' the wind, a resource not depleted long-term by extracting energy from it.

   Senate Bill 2094 was proposed in 2021, which seeks to amend the Commonwealth Act No. 146, also known as the Public Service Act, and ease the restriction on foreign investment in public services.[96] This does not amend the Renewable Energy Law or the Philippines Constitution, so does not affect OSW development, but suggests a willingness to soften the foreign ownership limitations.

7. Counterparty risks: No single or national offtaker for power supply agreements in the Philippines leads to risk of variance in the creditworthiness of offtakers. For wind projects that are eligible

for the FIT scheme, power supply agreements are signed between RE developers and Transco. For projects subject to power supply agreements, these will be with a distribution utility as counterparty. Each are separate entities with individual cash flow and credit risk profiles, and hence present lenders to a project with a unique set of counterparty risks to consider and evaluate. Establishing either a national offtaker similar to Vietnam or Taiwan, China or centralized coordinating body that can backstop offtaker obligations would minimize variance across market and improve investor and lender appetite for the OSW sector, increasing the availability and decreasing the cost of finance. Lenders will require a strong (or government-backed) offtaker able to deliver on a potentially rapidly growing set of contracts for OSW and beyond.

8. Policy or regulatory risks: A shift toward an auction scheme for RE instead of the existing FIT scheme could encourage developers to propose unsustainable tariffs. The DOE introduced the GEAP, a competitive process for the procurement of RE supply, including wind energy for an initial capacity of 2 GW.[97] A higher auction capacity is being considered given strong demand. While procuring RE, including OSW, through auctions is more transparent than a FIT scheme, the lack of sufficient precedent projects limits price certainty on equipment and operating costs that would come through a more mature market, giving rise to a risk of lowball bids by developers and diminishing developer margins and project solvency. Establishing a floor on pricing or requirement that bidders submit evidence of lender endorsement of proposed price may help alleviate this risk.

9. Contractual risks: A lack of a standardized PPA or offtake contract creates challenges in establishing market precedence. This implies that terms and conditions associated with energy offtake are agreed under bilateral negotiations on a project-by-project basis and as a result there is likely to be variance across projects, in turn increasing the level of due diligence needed by investors and lenders prior to making formal investment decisions. Through developing a standard form PPA for adoption across OSW projects, market development can be accelerated by minimizing variation in deal parameters and improving the predictability of terms.

10. Exchange rate risks: Adverse movements in Philippine peso relative to hard currencies such as US dollar could lead to reduced foreign investor appetite. This risk is of concern to local developers where a significant element of cost will be hard currency. For OSW, the majority of foreign currency denominated cost is anticipated to be in upfront capital cost, associated with the import of turbines and balance of plant. Ongoing operating costs are unlikely to require material foreign currency denominated input. There is opportunity for local developers to minimize foreign exchange risk through entering into hedging arrangements, such as foreign exchange swaps.[xxvi]

    There is strong precedent for foreign investment into the Philippines across various infrastructure sectors; however, foreign investors do face long-term exposure to adverse movements in Philippine peso, risking eroding their earnings over time when measured in hard currency. While foreign exchange swaps could be used, it is understood there may be limited market depth for long-dated foreign exchange swaps beyond a three to five-year horizon, in turn limiting ability to manage long-term exposure to currency fluctuation. ERC has the mandate to adjust tariffs annually to allow pass-through of foreign exchange rate variations for foreign investors.[98]

xxvi While there is currently strong dollar liquidity in the Philippines coming from foreign remittances, it might be tough to get currency hedges for greater than five years. Based on recent public service agreements (PSAs), it seems that if a project relies heavily on dollar imports, indexation is generally allowed.

11. Country risks: Local conditions stemming from the Philippines' political, economic, and legal framework could affect the stability of earnings. The Philippines has an investment grade sovereign credit rating (S&P BBB, Moody's Baa2) with a stable outlook, suggesting overall strength of the local economy. There is strong precedent of foreign direct investment into the Philippines as one of the few investment grade investment destinations in the Association of Southeast Asian Nations (ASEAN), but there have been examples where investment was not realized due to country risks that were not managed well. Local economic conditions such as high inflation or availability of suitably skilled labor could also affect project returns and debt serviceability.

    Similarly, the enforceability of contracts, both with the government (for example, WESCs) and suppliers, is key for OSW projects, with access to international arbitration essential. There is room for increased transparency in how WESCs are allocated to minimize risk of subsequent challenge. Establishing either a national offtaker or centralized coordinating body that can backstop offtaker obligations can help manage this risk but would require proper governance and oversight to build and maintain investor confidence.

20.5 RECOMMENDATIONS

Based on this analysis, the following are recommended that the DOE

- Accelerates implementation of EVOSS, including service pledges to encourage timely approvals and cooperation across government agencies and requirements for ESIAs standards and stakeholder engagement in line with GIIP and lender standards.
- Ensures coordinated national planning around renewable generation capacity and transmission network capacity to enhance certainty of offtake.
- Ensures clarity on compensation for delayed grid connection availability once GCA is signed.
- Ensures clarity on curtailment compensation (beyond a certain threshold).
- Explores establishing either a national offtaker or centralized coordinating body that can backstop offtaker obligations for multiple GW-scale projects.
- Considers establishing a floor on auction pricing or requirement that bidders submit evidence of lender endorsement of price.
- Explores the opportunity to develop a standard form PPA for adoption across OSW projects to accelerate market development that provides stable income per MWh generated and may also include indexation for foreign exchange rate variations.
- Considers support for lifting foreign ownership caps to higher levels.

21. FINANCE

21.1 PURPOSE

The cost of finance has a significant impact on power purchase agreement (PPA) prices and the cost to consumers. This section presents a high-level assessment of the potential role of broader public policy (including concessionary and climate finance) in the OSW rollout in the Philippines. It presents examples where public financial support has been used to enable other types of large infrastructure industries. It also considers the availability of local and international bank finance.

21.2 METHOD

We identified relevant financial instruments that could play an enabling role in the development of the Philippines OSW industry. We also identified several case studies that show a successful path to utilizing public and concessionary financing in the context of OSW.

21.3 RESULTS

We discuss seven categories of financial support relevant to minimizing cost of OSW to consumers, beyond equity provided by project owners:

- Enabling local and international bank lending
- Tax and policy incentives
- Multilateral lending
- Credit enhancement mechanisms
- Climate finance
- Green debt instruments
- Green equity instruments.

Enabling local and international bank lending

Globally, much debt finance in OSW has been provided by international banks. Enabling a competitive market for bank finance is a key way to minimize levelized cost of energy (LCOE). HSBC Global Research, in April 2021, ranked the Philippines as the second-best investment destination for renewable energy in the Asia-Pacific (APAC) region, second to Vietnam.[99]

Local banks

The Philippines has a strong local banking sector. According to the Bangko Sentral ng Pilipinas (BSP) in July 2021, the overall outlook in the domestic banking sector remains stable and is expected to remain so over the next two years despite the Covid-19 pandemic. While the economy has been adversely affected by the Covid-19 pandemic, the Philippines banking sector has a significant liquidity buffer to withstand adverse shocks as a result of prior regulatory change and several years of favorable banking conditions.[100] In November 2020, the liquidity coverage ratio of the local banking sector was 201 percent, which is double the regulatory minimum of 100 percent.[101] At least 71.3 percent of the respondent banks in the Banking Sector Outlook Survey second semester 2020 projected double-digit growth in their loan portfolios for the next two years.[102]

Local banks are increasing their public commitments to end coal financing and are looking at renewable energy to supplement deal pipelines. In November 2020, Rizal Commercial Banking Corporation (RCBC) was the first bank in the Philippines to announce its aim to end financing of coal-fired projects, to move toward renewable energy and gas-fired power facilities.[103] More recently in August 2021, the Bank of the Philippine Islands (BPI) announced its intention to stop all coal-fired projects by 2033 and to channel more funds toward renewable energy instead.[104] While other local banks have not made specific announcements on their commitment to finance renewable projects, BSP's push for banks to fully transition to sustainable financing in the next three years suggests that local banks will be increasingly prompted to embrace renewables projects.[105,106]

The BPI has been particularly active in financing onshore renewable energy projects. It first partnered with International Finance Corporation (IFC) on the Sustainable Energy Finance (SEF) Program in 2009, providing access to capital and technical support for renewable project developers. This included two wind projects with a combined capacity of 51 MW in the first eight years of the program.[107] The bank has also developed a Sustainable Funding Framework with the intention of providing green loans or advice on green bond issuance for eligible projects, including wind.[108] The SEF model has been replicated by other local banks such as Banco de Oro (BDO), which has financed 45 renewables projects in the Philippines to date. The scale of OSW projects is however quite different to what has so far been financed onshore.

State-owned banks have also provided financing for renewable energy projects. State-owned banks such as the Development Bank of the Philippines (DBP) and the Land Bank of the Philippines have provided finance for renewable energy projects. These banks receive official development assistance (ODA) funds intended to support developmental projects that are not able to attract mainstream capital, including for energy infrastructure.[109] The 54 MW San Lorenzo wind farm was partially funded by DBP through project financing that amounted to US$85.1 million (PHP 4.3 billion) in 2013.[110] The bank recently engaged with Terasu Energy on a US$24 million (PHP 1.65 billion) loan agreement to partially finance the development of a 40 MW solar plant in Concepcion, Tarlac.[111] Given the development focus of such lenders, they may be a good source of financing for early OSW projects.

Traditional limited or non-recourse project financing has not historically been a feature of renewable energy projects in the Philippines, but this is starting to change. Renewable energy projects have been historically financed on a corporate basis with recourse back to sponsor balance sheets, but Energy Development Corporation (EDC) secured a US$315 million (PHP 21.7 billion) loan with leading foreign and local banks for the 150 MW Burgos onshore wind farm. The finance facility is denominated in US dollars and Philippine pesos, with a loan tenor of 15 years.[112] Denmark's export credit agency, Eksport Kredit Fonden (EKF), provided credit enhancement to a proportion of the US dollar component, which was a key element of getting commercial lenders comfortable with the non-recourse financing structure. The experience suggests that MDBs have a role to play in de-risking the OSW sector, by unlocking access to capital until such time as sufficient local track record has been established.

The single borrower limit requirement in the Philippines[xxvii] results in local banks having to explore new clients to minimize the risk of reaching single borrower limit and diversify risk. This is favorable to new OSW developers as local banks continue to seek to diversify.

International banks

While international banks have experience in financing renewable energy assets in the Philippines, local banks and MDBs have dominated. Australia and New Zealand Banking Group (ANZ) and ING Bank have been involved in the financing of large-scale wind assets. In 2014, ANZ acted as lead arranger of the Burgos onshore wind farm. This consisted of three 15-year tranches: 40 percent from a Philippine peso tranche (provided by a domestic bank syndicate) and 60 percent from two US dollar tranches. Despite appetite from overseas lenders, they have limited peso balance sheets and limited liquidity in long dated swap markets. This requires developers to either borrow in US dollars and accept a level of foreign exchange risk if looking to leverage the appetite of foreign banks or pivot toward local lenders.

Table 21.1 outlines a selection of bank-financed onshore wind energy projects in the Philippines where lender groups have been publicly disclosed.

TABLE 21.1 FINANCING DETAILS OF FIVE ONSHORE WIND ENERGY PROJECTS[114,115,116,117,118,119]

Project Name	Project developer	Debt providers	Amount (US$, millions)	Financing year
Mindanao (160 MW)	Shizen Energy	Japan's Ministry of Economy, Trade and Industry	300	2017
Pililla (54 MW)	Alternergy Wind One Corporation	BDO, Rizal Commercial Banking Corporation, China Banking Corporation	178	2015
Burgos (150 MW)	Energy Development Corporation	Asian Development Bank (ADB), ANZ, DZ Bank, ING Group, NordLB, Philippine National Bank, Security Bank, BDO, Land Bank of the Philippines, Maybank, Bank of the Philippine Islands, Philippine Commercial Capital, Rizal Commercial Banking Corporation, BPI Capital Corporation	315	2014
San Lorenzo (54 MW)	Trans-Asia Oil & Energy Development	Development Bank of the Philippines, Security Bank	141	2013
Bangui Bay (33 MW)	Ayala Corporation, NorthWind Power Development Corporation	World Bank, ABN Amro, and Nordea	20	2011

xxvii This limits lending by a bank to a single client to 25 percent (increased to 30 percent temporarily until December 2021) to spread the risk of losses from non-paying borrowers to ensure stability of banks and the financial sector.

Tax and policy incentives

Several tax and policy incentives are already in place for renewable energy projects in the Philippines. The National Renewable Energy Program introduced a number of tax and policy incentives to accelerate the development and use of renewable energy resources, including OSW, by reducing the tax burden on projects. Current incentives include the following:[89]

- *Accelerated depreciation.* If the renewable energy project fails to receive an income tax holiday before full operation, it may apply for accelerated depreciation through either the declining balance method or the sum-of-the-years' digit method.
- *Cash incentive for missionary electrification.* Developers of renewable energy projects for missionary electrification are entitled to a cash incentive per kilowatt-hour rate generated.
- *Duty-free import of equipment.* This incentive is valid for ten years after a certification of entitlement to incentives is issued.
- *Income tax holiday and low-income tax rate.* Income tax exemption is for the first seven years of commercial operations. Corporate income tax (CIT) rate of 10 percent on net taxable income is valid after the income tax holiday.
- *Net Operating Loss Carry-Over (NOLCO).* Losses during the first three years from start of commercial operation can be carried over as a deduction from gross income for the next seven consecutive years.
- *Special realty tax rate on equipment and machinery.* These taxes on civil works, equipment, machinery, and other improvements exclusively used for renewable energy facilities cannot exceed 1.5 percent of their original costs.
- *Tax exemption on carbon credits.* There is tax exemption on all proceeds from the sale of carbon emission credits.
- *Tax credit on domestic capital equipment and services.* This tax credit is equivalent to 100 percent of the combined value added tax (VAT) and customs duties on renewable energy machinery and equipment had these items been imported. This is given to a renewable energy project developer that purchases the machinery and equipment from a domestic manufacturer or supplier.
- *Zero percent VAT rate.* Applies to (a) sale of fuel or power generated from renewable energy sources; (b) local supply of goods, properties, and services needed for the development, construction, and installation of plant facilities; and (c) process of exploring and developing renewable energy sources for conversion into power, including, but not limited to, the services of subcontractors and/or contractors.

These incentives directly lead to cost reductions for developers, reducing the amount they that needs to be recovered through revenue.

Given the substantial overlap between the energy consumers paying tariffs and taxpayers, these policies are less likely to be effective where the concern is the overall level of affordability to the Philippines as a country. They may have advantages where particular distributional outcomes are more difficult to achieve with the tariff regime than with the tax regime.

Government reducing project developer risk by acting as a backstop on offtaker (PPA counterparty) obligations is also an option.

Multilateral lending

The ability of private sector developers to secure finance from MDBs such as IFC, ADB, and European Investment Bank (EIB) can create several benefits in terms of the overall availability of finance and associated cost.

Participation (in equity or, more typically, debt) of multilateral lenders has several benefits. For the sectors they prioritize, they will typically offer a source of lower-cost finance. Participation is also likely to increase the appetite of other lenders because

- They are often willing to take on a larger tranche of financing for early, higher-risk projects;
- Their presence often increases interest among private institutions;
- Their environmental and social impact assessment (ESIA) standards such as IFC Performance Standards ensure that best practice in ESIA is applied, making it easier for other investors to participate—this is aided by regulatory requirements ensuring that ESIAs and permits meet such standards and other GIIP;
- Their due diligence processes are often relied on by others, reducing the cost of participation by private financing parties; and
- Their participation often comes with other support, either advisory or in terms of credit enhancement.

Multilateral lenders may offer concessional loans (loans on more favorable terms than market loans, either lower than standard market interest rates, longer tenors, or a combination of these terms) which have been used previously in the Philippines.

Where there are particular areas of priority, MDBs may also participate at the equity level in projects (or provide convertible debt). This can help ensure there is available finance, particularly for up-front development costs before debt financing is available.

MDBs have played an important role in providing financing to renewable energy projects and stimulating private investment. In 2009, the Philippines received US$250 million (PHP 12.6 billion) from the Climate Investment Fund to provide concessional financing to climate-related projects, including renewable energy. Under the leadership of the Government, ADB, and the World Bank Group (WBG), it used the funding to implement various programs.[112] The SEF Program was launched by IFC with the aim of mobilizing local financing. IFC provided two financial products to four local private banks: a risk sharing facility and line of credit. This helped partner banks reduce economic capital required to hold renewable energy loans and to offer loans with tenors of at least five years. As a result, partner banks have provided direct loans worth US$439 million (PHP 22.2 billion) in total to finance 118 renewable energy or energy efficiency projects.[113]

Examples of instruments that have already been implemented in the local context are infrastructure guarantee mechanisms (guarantee funds and credit guarantee) and first-loss provisions. In 2010, ADB established the Credit Guarantee and Investment Facility to provide guarantees for local currency denominated bonds issued by companies in Philippines and the wider region. Such credit guarantees make it easier for companies to issue local currency bonds with longer maturities as they reduce risk to bond investors.

A list of active projects, including financing details, is provided in Table 21.2. MDBs are also active in the issuance of green bonds (see below).

TABLE 21.2 SELECTION OF ACTIVE MDB-FUNDED RENEWABLE ENERGY PROJECTS IN THE PHILIPPINES

MDB	Project Name	Finance Type	Description	Amount
ADB	Tiwi and MakBan Geothermal Project	Loan, guarantee	Project loan in pesos and a credit enhancement (in the form of a partial credit guarantee in pesos) to support the issuance of the Philippines' first peso-denominated green project bond for refinancing of a geothermal plant	US$35.6 million (loan), US$158.2 million (guarantee)
ADB	150 MW Burgos Wind Farm Project	Loan	Construction and operation	US$20 million

Credit enhancement mechanisms

While credit enhancement mechanisms from MDBs have been used to address the offtaker's credit risk, the type of credit enhancement mechanisms in the Philippines is limited. Credit enhancement instruments are used to improve the credit risk profile of a business, which should lead to reductions in financing costs. These credit enhancement mechanisms can be deployed by national entities or as part of participation in a project by an MDB; the latter is more common in the Philippines. We note that some of the credit enhancement mechanisms such as political risk guarantees may overlap with some of our suggestions of risk mitigation solutions discussed in Section 20. Some common credit enhancement mechanisms used in other Southeast Asia countries such as Vietnam include partial risk, project completion risk, and political risk guarantees. Such products are yet to be used for renewable energy projects in the Philippines.

Climate finance

Climate finance refers to sources of public finance aimed at supporting developing economies to make investments that mitigate climate change and adapt to its impacts. The impetus for global climate finance funds comes from the United Nations Framework Convention on Climate Change (UNFCC).

The UNFCC calls for financial assistance from countries with greater financial resources (Annex 1 countries) to those that require assistance to address climate change (non-Annex 1 countries). The Philippines is a non-Annex 1 country due to its heavy economic reliance on fossil fuel production and related commerce.

The UNFCC Paris Agreement developed plans for an annual US$100 billion climate finance fund to be made available to non-Annex 1 countries, funded by financial commitments from Annex 1 countries. This goal was reemphasized at COP26 in November 2021 as part of the Glasgow Climate Pact.[126]

The main climate finance mechanisms are the Green Climate Fund (GCF), the Global Environment Facility (GEF), and the Climate Investment Funds (CIF).

The GCF is the centerpiece of efforts to raise climate finance under the UNFCC. It supports projects, programs, and policies in developing economies. As a non-Annex 1 country, the Philippines is eligible to receive GCF funding.[127] The Department of Finance (DOF) is the designated authority in the Philippines for the implementation of GCF funding.

The GEF provides funding to assist developing countries in meeting the objectives of international environmental conventions. Regarding renewable energy, GEF funds can be deployed to address policy, regulatory, and technical barriers to the adoption of renewable energy technology, to build capacity, and to finance investments in renewable energy, including demonstration projects. The Philippines is eligible to receive assistance from the GEF.

CIF is administered by the World Bank in partnership with the African Development Bank (AfDB), ADB, European Bank for Reconstruction and Development (EBRD), and the Inter-American Development Bank (IDB). The Philippines is eligible for support from the CIF.

CIF operates through various financing windows including the Clean Technology Fund (CTF) and the Special Climate Change Fund (SCF). These various funding programs provide financing to low- and middle-income countries. Renewable energy programs under the CIF include the following:

- Scaling up technologies that enable renewable energy, like storage solutions, grid management, and green fuels
- Enhancing infrastructure to be renewable energy ready through smart grids and grid interconnections
- Supporting renewable energy innovation, for example, by empowering consumers to contribute actively to demand-side management
- Enhancing system and market design and operation, through regulatory change and procedural innovation.

The GCF, GEF, and CIF can be used to enable access to additional private finance.

The Philippines' eligibility to these sources of climate finance offers an opportunity to progress and accelerate the OSW program, including the funding of enabling activities, development of the demonstration project, decarbonization of the energy system, and strengthening of transmission infrastructure.

Green debt instruments

Green debt instruments are bonds or securities issued to fund projects or assets that have a positive environmental or climate impact. These bonds can be issued either by public or private actors and may bring the following benefits:

- Enhancements to the issuer's reputation, as green bonds serve to enhance their commitment to environmental goals or targets.
- Requirement of good standards of ESIA to be applied.
- Investor diversification, as there is a growing pool of capital earmarked for green projects. Thus, the issuer can access investors who may not have been interested in purchasing a regular bond.
- Potential pricing advantages if the wider investor base allows the issuer to get better pricing terms on a green bond than on a regular bond, though evidence to support the existence of a pricing advantage is mixed.

IFC and Amundi Asset Management launched the Green Cornerstone Bond Fund in 2018, the world's largest green bond fund targeting emerging markets, including the Philippines. IFC will provide first-loss coverage through a junior tranche to lower risk and attract private sector investments.[129]

Green bonds have been issued to finance renewable energy projects in the country, and green bond issuance is expected to grow in line with global trends, though there is limited precedent of 'project bonds' with no recourse to a corporate issuer/sponsor. As of June 2021, larger banks in the Philippines have issued US$2.8 billion (PHP 141.6 billion) worth of green and sustainability bonds to finance sustainable infrastructure in the country, including renewable energy projects.[130] The Philippines was also cited by the Climate Bonds Initiative as a regional leader in green finance in Southeast Asia, driven by the country's initiatives on green bonds, loans and equity, credit guarantees, and specialty funds for green infrastructure and renewable energy.[131] AP Renewables, a subsidiary of Aboitiz, issued the first green bond in the Association of Southeast Asian Nations (ASEAN) in 2016 to finance the TiwiMakBan geothermal project. Since then, Philippines-linked issuers have continued issuing green bonds and debt instruments to finance renewable energy projects in the country.

- Supra-national green bonds: Financing of nominated projects or assets. Credit rating is based on the issuing supra-national. An example is the Mubuhay bond, which was the first peso-denominated triple A bond issued by IFC to repair the Malitbog Geothermal Power station.[132]
- Green project bonds (project finance): Financing of nominated projects or assets. Credit rating is based on the quality of the backing green assets and the returns stream. An example is the first green bond issued by AP Renewables in 2016 for the TiwiMakBan geothermal project.[133]
- Private placement: Green bond placed directly with investors. BDO issued its first green bond investment of US$150 million (PHP 7.6 billion) to finance climate-smart projects including renewable energy, with IFC being the sole investor in this issuance.[134]
- Perpetual green bonds: Fixed income security with no maturity date.[135]

The growth of the green bond market has been driven by MDBs, corporates, and private local banks. No green bond has been issued exclusively to finance wind projects, though larger green bond issuances have had wind projects as part of the portfolios of activities being financed. As of August 2020, the estimated total value of green bonds that have been issued by Philippine entities is US$2.6 billion (PHP 131.5 billion), with most of the proceeds used to finance renewable energy projects.[136] IFC and ADB have acted as anchor investors for a number of green bonds, with the aim of crowding-in other institutional investors. The largest green bond issuer in the Philippines is AC Energy Corporation, the listed energy platform of the Ayala Group. To date, five local (only one state-owned) banks have issued green bonds in either local or foreign currency. Recent green bonds that have been issued in the country include the following:

- Rizal Commercial Banking Corporation issued a US$296.5 million (PHP 15 billion) green bond to support the bank's expansion of green initiatives. The proceeds will be allocated to fund and refinance loans issued for various green initiatives, including renewable energy.
- DBP issued a US$357.8 million (PHP 18.1 billion) sustainability bond, with some proceeds going to green initiatives within three DBP programs, including Financing Utilities for Sustainable Energy Development.[137]
- AC Energy Corporation first issued a total of US$300 million (PHP 15.2 billion) five-year green bonds in two tranches. The 2019 issuance was supported by a US$75 million (PHP 3.8 billion) IFC investment. Proceeds were allocated to 5 GW of renewable energy projects in the region, including geothermal, solar, and wind. Then, in 2021, AC Energy Corporation issued a US$400 million (PHP 20.2 billion) green bond to finance photovoltaic solar and onshore wind projects.

Green equity instruments

Green equity instruments relate to equity issuances by a company where the capital raised is to be used specifically for projects that have a positive environmental impact.

There are currently two main green equity instruments being used in the Philippines that are relevant to the financing of OSW.

- Private equity/venture capital/unlisted equity funds that aid project developers to secure a funding stream for their projects. For example, the Renewable Energy Asia Fund is a private equity fund managed by Berkley Energy investing in small hydro, wind, geothermal, solar, and biomass projects. Global investors are also starting to invest in renewable energy projects in the Philippines. For example, in 2019, Singapore's Wenergy Global and its venture partners invested US$20 million (PHP 1 billion) in equity for four new energy projects in the Philippines.
- Joint venture partnerships that pool capital, skills, and resources for a specific project. For example, Siemens Gamesa has partnered with UPC Renewables and AC Energy Corporation to build the Balaoi and Caunayan onshore wind farm.[138]

21.4 DISCUSSION

There are a number of viable sources of finance for OSW developments and a track record of renewable transactions across loan, bond, green bond, and equity markets. We anticipate that the greatest volume of finance will come from international lenders, with local lenders and MDBs playing an important role. A well-informed, competitive debt market supporting experienced project developers that are able to show their commitment through equity investment is key to minimizing WACC for OSW projects.

- International lenders are active in the Philippines market. Many of these have experience with OSW through other Asian markets, including Japan, Korea, and Taiwan, China, but have limited peso-denominated balance sheets and therefore are likely to seek part of the loan proceeds in US dollars, giving rise to the need to manage foreign currency exchange risk.
- The Philippines has an established and active banking market. Local lenders have a growing appetite for renewables and growing familiarity with project finance structures. They are well capitalized and ready to lend but lack significant experience with OSW.
- MDBs are active and familiar with the Philippines context. They have a role to play in 'de-risking' OSW development in the coming years until there is a greater local track record of successfully operational OSW projects. Direct lending and credit enhancement appear to be suitable tools to unlock private sources of debt that are otherwise available in the country.
- The Philippines green bond market is small but growing. Given the small pool of investors and the need for a minimum credit rating, raising project bonds without credit enhancement is likely to be challenging in the short term. Larger corporate developers may be able to secure bond issuance (and green bonds) as part of corporate bond programs, which in turn could be used to fund OSW.
- Government has established a series of tax and policy measures aimed at encouraging the purchase of renewable energy and reducing tax costs to developers and renewables operators.

21.5 RECOMMENDATIONS

Based on this analysis, the following are recommended:

- The DOE requires that frameworks and ESIAs are fully aligned with GIIP and lender requirements.
- The DOF encourages financial mechanisms to reduce cost of capital for OSW projects, including access to climate and other concessional finance, and ensures international market standards for contractual risk allocation, arbitration and Government backstop, and an adequate security package for lenders. Early engagement with MDBs is encouraged, to shape any guarantee scheme, credit enhancement, first-loss support, or other arrangement.
- The DOE supports the engagement of local finance community with OSW.
- The DOE considers, with the DOF, any refinement of tax and policy incentives to support OSW and any measures to manage exchange rate risk (for example, a limited pass-through of US dollar tariff to customers or absorption by the Government).

22. STAKEHOLDERS

One of the goals of the project is to establish a strong network of industry stakeholders whose views and collaboration will aid development and socialization of the OSW roadmap for the Philippines. The engagement carried out in the inception mission and consultation mission of this roadmap aimed to start the establishing of such a network. Key stakeholders identified during the missions are listed below.

Early and constructive stakeholder engagement is essential for a number of reasons.

- Working together with industry to address recommendations in this roadmap and other considerations
- Providing input into policy and frameworks
- Identifying priority biodiversity values, verifying data, and ensuring they are considered appropriately and proportionately in planning for OSW development.

Stakeholder engagement should be an integral and important part of future processes, including MSP and ESIA. A list of key stakeholders has been identified and is provided in Table 22.1 under seven headings:

- *Government.* Government departments, regulators, and institutions at the national and regional levels. This list includes government owned or controlled corporations (GOCCs) and private corporations with congressional franchises performing relevant governmental functions.
- *Offtakers.* Electricity companies that would likely be involved in distributing energy from OSW.
- *Project developers.* OSW project developers known to be active or interested in the Philippines.
- *OSW supply chain.* Supply chain businesses known to be active in OSW in the Philippines or those with potential to provide services.
- *Nongovernmental organizations (NGOs).* National and international NGOs with an interest in OSW in the Philippines.
- *Academics.* Academic organizations with relevance or declared interest in OSW in the Philippines.
- *Overseas governments.* Offices that have declared interest in OSW in the Philippines.

This list is dynamic and as interest in the market continues to increase, it will be outdated soon after publication.

TABLE 22.1 KEY STAKEHOLDERS

Name	Role
Government	
Biodiversity Management Bureau	Agency of the Department of Environment and Natural Resources responsible for formulating and recommending policies, guidelines, rules, and regulations for the establishment and management of national parks, wildlife sanctuaries and refuge, marine parks, and bio-spheric reserves
Board of Investments	Agency of the Department of Trade and Industry responsible for the development of investments in the Philippines
Bureau of Fisheries and Aquatics Resources	Agency of the Department of Agriculture responsible for the development, improvement, management, and conservation of the country's fisheries and aquatic resources
Construction Industry Authority of the Philippines	Agency of the DTI responsible for promoting, accelerating, and regulating the growth and development of the construction industry
The Department of Agriculture	Government department responsible for the promotion of agricultural and fisheries development and growth
The Department of Energy	Government department responsible for the preparation, integration, coordination, supervision, and control of all plans, programs, projects, and activities of the Government related to energy exploration, development, utilization, distribution, and conservation
The Department of Environment and Natural Resources	Government department responsible for the conservation, management, development, and proper use of the country's environment and natural resources, including those in reservations, watershed areas, and lands of the public domain; also responsible for the licensing and regulation of all natural resource utilization
The Department of Finance	Government department responsible for the formulation, institutionalization, and administration of fiscal policies in coordination with other concerned subdivisions, agencies, and instrumentalities of government
The Department of Interior and Local Government	Government department responsible for assisting the President in general supervision over local governments
The Department of National Defense	Government department responsible for guarding against external and internal threats to peace and security
The Department of Tourism	Government department responsible for the regulation and promotion of the Philippine tourism industry
The Department of Trade and Industry	Government department responsible for the regulation, management, and growth of industry and trade
The Department of Transportation	Government department responsible for the promotion, development, and regulation of transportation systems and transportation services
Ecosystem Research and Development Bureau	Agency of the DENR responsible for production and sustainable land use that combines fish production and planting of nipa and agricultural crops
Energy Regulatory Commission	Regulator responsible for promoting competition, encouraging market development, ensuring customer choice, and penalizing abuse of market power in the electricity industry

Name	Role
Environmental Management Bureau	Agency of the DENR responsible for formulating, integrating, coordinating, supervising, and implementing national environmental laws and setting appropriate environmental quality standards (water, air, and noise) for the prevention, control of pollution, and protection of the environment
Local Government Unit	Has specific role in the project leasing and permitting processes
Maritime Industry Authority	Agency of the DoTr responsible for the development of the maritime industry of the Philippines and development and regulation of shipping enterprises
National Commission on Indigenous Peoples	Agency of government responsible for protecting the rights of the indigenous peoples of the Philippines
National Economic and Development Authority	Independent government agency responsible for formulating and continuing coordinated and fully integrated social and economic policies, plans, and programs
National Fisheries Research and Development institute	Research institute under BFAR
National Mapping and Resource Information Authority	Agency of the DENR responsible for providing the public with mapmaking services and acting as the central mapping agency, depository, and distribution facilities for natural resources data in the form of maps, charts, texts, and statistics
National Renewable Energy Board	Advisory body responsible for recommending renewable energy policies to the DOE
Natural Resources Development Corporation	Agency of the DENR responsible for promoting and undertaking the development and use of technologies and systems that complement the utilization of natural resources
Philippine Coast Guard	Civilian armed uniformed service attached to the DOT responsible for enforcing laws, conducting maritime security operations, safeguarding life and property at sea, and protecting marine environment and resources
Philippine Council for Agriculture, Aquatic, and Natural Resources Research and Development	Council of the Department of Science and Technology responsible for helping national research and development efforts in agriculture, forestry, and natural resources of the Philippines.
Philippine Ports Authority	Agency of the DOTr responsible for port planning, development, operations, and regulation
Technical Education and Skills Development Authority	Agency responsible for managing and supervising the Philippines' technical education and skills development
Offtakers and power companies (some state owned)	
Aboitiz	Private power distribution company
MERALCO PowerGen	Private power distribution company
National Grid Power Corporation	Private corporation responsible for operating, maintaining, and developing the country's state-owned transmission network under a long-term franchise contract
National Power Corporation	Government-owned-and-controlled corporation responsible for undertaking the development of hydroelectric generation of power and the production of electricity from nuclear, geothermal, and other sources

Name	Role
National Transmission Corporation	Owns all transmission assets
Philippines National Oil Company – Renewable Corporation	Subsidiary of the state-owned Philippines National Oil Company, mandated to pursue and implement projects on new, renewable, non-conventional, and environment-friendly energy sources and systems
Project developers	
AC Energy	Holds, has applied for, or has issued letter of intent for an OSW wind energy service contract, alone or in partnership
ACX3 Capital Holdings	Holds, has applied for, or has issued letter of intent for an OSW WESC, alone or in partnership
CleanTech Global Renewables	Holds, has applied for, or has issued letter of intent for an OSW WESC, alone or in partnership
Copenhagen Energy	International developer with declared interest in OSW in the Philippines
Earth Sol Power Corporation	Holds, has applied for, or has issued letter of intent for an OSW WESC, alone or in partnership
Energy Development Corporation	Philippines-based developer with declared interest in OSW in the Philippines
Equinor	International developer with declared interest in OSW in the Philippines
FirstGen	Philippines-based developer with declared interest in OSW in the Philippines
Giga ace 7	Holds, has applied for, or has issued letter of intent for an OSW WESC, alone or in partnership
GIGAWIND5	Holds, has applied for, or has issued letter of intent for an OSW WESC, alone or in partnership
Ivisan Windkraft Corporation	Holds, has applied for, or has issued letter of intent for an OSW WESC, alone or in partnership
Jet Stream Windkraft	Holds, has applied for, or has issued letter of intent for an OSW WESC, alone or in partnership
Macquarie Renewable Energy Group	International developer with declared interest in OSW in the Philippines
Mainstream Renewable Energy Power	International developer with declared interest in OSW in the Philippines
Northland Power	International developer with declared interest in OSW in the Philippines
OceanWinds	International developer with declared interest in OSW in the Philippines
PetroGreen Energy Corporation	Holds, has applied for, or has issued letter of intent for an OSW WESC, alone or in partnership
Scatec ASA	International developer with declared interest in OSW in the Philippines
Shell	International developer with declared interest in OSW in the Philippines
Sitex Windkraft Corporation	Holds, has applied for, or has issued letter of intent for an OSW WESC, alone or in partnership
TotalPower	Holds, has applied for, or has issued letter of intent for an OSW WESC, alone or in partnership

Name	Role
Triconti Southwind Corporation	Holds, has applied for, or has issued letter of intent for an OSW WESC, alone or in partnership
Vena Energy	International developer with declared interest in OSW in the Philippines
Vind Energy Corporation	Holds, has applied for, or has issued letter of intent for an OSW WESC, alone or in partnership
wpd	Holds, has applied for, or has issued letter of intent for an OSW WESC, alone or in partnership
OSW supply chain	
Atlantic Gulf and Pacific Company	Supply chain business (towers, floating foundations, offshore substation)
Bauer International	Supply chain business (floating foundations)
EEI Corporation	Supply chain business (towers, floating foundations, offshore substation)
First Balfour	Supply chain business (onshore infrastructure)
Fluor	Supply chain business (towers, floating foundations, offshore substation)
General Electric Renewable Energy	International OSW turbine supplier
Grandspan Development Corporation	Supply chain business (onshore infrastructure)
Keppel	Supply chain business (towers, floating foundations, offshore substation, turbine and foundation installation, decommissioning)
Siemens Gamesa Renewable Energy	International OSW turbine supplier
Vestas	International OSW turbine supplier
NGOs	
Biodiversity Conservation Society of the Philippines	National NGO
Conservation International Philippines	International NGO
Coral Cay Conservation	National NGO
Developers of Renewable Energy for AdvanceMent, Inc	Philippines-based renewable energy developers association
Foundation for the Philippine Environment	National NGO
Global Mangrove Alliance	International NGO
Haribon Foundation	National NGO
Large Marine Vertebrates Research Institute Philippines	National NGO
Marine Conservation Philippines	National NGO
Marine Wildlife Watch of the Philippines	National NGO
Oceana Philippines	International NGO
People and the Sea	National NGO
Philippine Mangroves: Biodiversity, Conservation and Management	National NGO
Quantitative Aquatics, Inc.	National NGO

Name	Role
Rare	International NGO
Save Philippine Seas	National NGO
Sea Around Us Fisheries, Ecosystems & Biodiversity	International NGO
Seagrass Watch Philippines	International NGO
Sea Institute	National NGO
Society for Conservation of Philippine Wetlands	National NGO
Sustainable Fisheries Partnership	International NGO
The Philippine Marine Mammal Stranding Network (PMMSN)	National NGO
Wind Energy Developers Association of the Philippines	Wind energy association
World Wildlife Foundation Philippines	International NGO
Academics	
University of the Philippines Marine Science Institute	Academic institute
The University of Philippines Marine Mammal Research & Stranding Laboratory	Academic institute
De La Salle University Br. Alfred Shields FSC Ocean Research Center	Academic institute
Overseas governments	
British Embassy, Manila	Embassy that has expressed interest in OSW in the Philippines
Danish Embassy, Manila	Embassy that has expressed interest in OSW in the Philippines
Foreign, Commonwealth and Development Office	British Government department which leads the ASEAN Low Carbon Energy Programme, active with the DOE
See Appendix for other environmental stakeholders	

APPENDIX:
PRIORITY BIODIVERSITY VALUES

1. INTRODUCTION

The World Bank Group (WBG) commissioned The Biodiversity Consultancy to provide environmental support for the WBG Offshore Wind Development Program. This support includes the completion of early-stage identification of priority biodiversity values and available spatial data to inform the offshore wind country roadmap for the Philippines. Incorporating considerations of priority biodiversity values in the assessment of 'practical potential' for offshore wind development is essential to avoid adverse impacts from inappropriate development and provide a foundation for a pipeline of bankable projects eligible for funding by international finance Institutions.

The World Bank and International Finance Corporation (IFC) environment and social requirements are integral to the Offshore Wind Development Program and the production of individual country roadmaps. They enable the World Bank, IFC, and client countries to better manage the environmental and social risks of projects and to improve development outcomes. The World Bank Environmental and Social Framework and the IFC Sustainability Framework promote sound environmental and social practices, transparency, and accountability. These frameworks define client responsibilities for managing risks and ensure that offshore wind sector preparatory work is aligned with GIIP. Of particular relevance to this study are

- World Bank Environmental and Social Standard 6 (ESS6) Biodiversity Conservation and Sustainable Management of Living Natural Resources (2018), together with the associated Guidance Note ESS6 (2018) and
- IFC Environmental and Social Performance Standard 6 (PS6): Biodiversity Conservation and Sustainable Management of Living Natural Resources (2012), together with the associated Guidance Note 6 (2019).

The objective of this study is to identify priority biodiversity values and areas that support these values that should either be excluded from offshore wind development (that is, areas of the highest biodiversity sensitivity) or require additional assessment through subsequent MSP, site selection, and ESIA processes. To meet GIIP, wind developments in areas supporting priority biodiversity values would likely be subject to restrictions in the form of greater requirements for baseline studies, as well as more intensive mitigation measures to avoid, minimize, and restore adverse environmental impacts. According to IFC PS6 and World Bank ESS6, projects situated within critical habitats are required to demonstrate that:

- No other viable alternatives within the region exist for development of the project on modified or natural habitat that are not critical;
- The project does not lead to measurable adverse impacts on those biodiversity values for which the critical habitat was designated, and on the ecological processes supporting those biodiversity values;

- The project does not lead to a net reduction in the global and/or national/regional population of any critically endangered or endangered species over a reasonable period of time; and
- A robust, appropriately designed, and long-term biodiversity monitoring and evaluation program is integrated into the client's management program.

In addition, projects need to achieve net gains of those biodiversity values for which the critical habitat was identified.

This study has focused on the following key groups of priority biodiversity values, which have been identified through a review of the scientific literature and on experiences in well-developed offshore wind markets:

- Legally Protected Areas and Internationally Recognized Areas - see Section 3
- Natural Habitats - see Section 4
- Cartilaginous Fish - see Section 5
- Marine Turtles - see Section 6
- Birds - see Section 7
- Marine Mammals- see Section 8.

2. METHODOLOGY

For each group of priority biodiversity values, the available global and regional spatial datasets were identified and screened for inclusion in one of two spatial data layers for use in the country roadmap:

1. Exclusion zone (that is, areas of the highest biodiversity sensitivity to exclude from the technical assessment of offshore wind resource) and
2. Restriction zone (that is, high-risk areas requiring further assessment of risk during MSP, site selection, and/or ESIA).

Numerous global and regional biodiversity datasets exist (primarily produced by academic, scientific, government, and nongovernmental organizations [NGOs]) and are useful and important resources. Broadly, these datasets provide an indication of the distribution of given biodiversity values. For example, datasets show

- Verified point records of species occurrence;
- Species range maps;
- The extent of a particular habitat or ecosystem type, or location of key habitat features;
- Modelled indicative habitat suitability; and
- The boundaries of globally important LPAs and internationally recognized areas (IRAs) that represent areas of high biodiversity conservation value.

Threatened and range-restricted species are the focus of criteria 1 and 2 for the determination of critical habitat, as defined by IFC PS6 and therefore represent priority biodiversity values. As a foundational stage, the IUCN Red List was screened to identify all threatened and all range-restricted[i] marine species with global ranges that overlap with the Philippine Exclusive Economic Zone (EEZ). A full list of the identified threatened species is provided in Table 10.

A detailed literature search was completed to identify spatial data and additional contextual information on these species. In addition to identifying digitized spatial data, many supplementary data sources that provide more detailed information on relevant priority biodiversity values were identified. These sources provide a valuable resource for future MSP, site selection, and ESIA stages of offshore wind development in the Philippines and are listed in Table 11, along with a short commentary on each dataset highlighting its suitability for MSP.

Early and constructive stakeholder engagement is an essential component of identifying priority biodiversity values, verifying data, and ensuring they are considered appropriately and proportionately in planning for offshore wind development. Stakeholder engagement should be an integral and important part of future MSP and ESIA processes, and a list of relevant environmental stakeholders has been identified and is provided in Table 12.

3. LEGALLY PROTECTED AREAS AND INTERNATIONALLY RECOGNIZED AREAS

Following the IUCN definition, a LPA is any clearly defined geographical space, recognized, dedicated, and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values.[ii] Internationally recognized areas (IRAs) are exclusively defined in IFC PS6 as UNESCO Natural World Heritage Sites, UNESCO MAB Reserves, KBAs, and wetlands designated under the Convention on Wetlands of International Importance (the Ramsar Convention).[iii]

LPAs and IRAs represent high-value areas designated for various biodiversity conservation objectives, and some should be excluded from consideration for offshore wind development because of this. For example, development in KBAs (see Section 3.3) should be avoided because these sites represent the most important places in the world for species and their habitats.[iv] It may also be necessary to avoid other types of designated areas, such as EBSAs (see Section3.5), or UNESCO-MAB Reserves (see Section 3.6). To note, IFC standards prohibit development in AZE sites and UNESCO Natural and Mixed World Heritage Sites.[v] In the Philippines, three of the twelve AZE sites have coastal and marine components (see Section 3.2.2). There are also two designated World Heritage Natural Sites with coastal and marine components and another six sites on the tentative list (see Section 3.6).

1 Range-restricted marine species are defined by IFC PS6 as having an Extent of occurrence less than 100,000 km2

ii Dudley 2008; IFC 2012.

iii IFC 2012.

iv KBA n.d.

v IFC 2019.

3.1 Nationally protected areas

Protected areas are afforded varying levels of legal protection in different national jurisdictions, often underpinned by commitments made under international conventions. The Philippines Congress has the sole authority to establish protected areas through a national legislative act. Two landmark laws—Republic Act No. 7586 NIPAS Act of 1992 and Republic Act No. 11038 ENIPAS Act of 2018—determine the legal basis for protected natural areas in the Philippines, which comprise 39 percent of the total area of the country. There is a range of LPA types, which are aligned with the IUCN protected area management categories[vi] (Table 1).

TABLE 1: THE PHILIPPINE LPA ALIGNMENT WITH THE IUCN PROTECTED AREA MANAGEMENT CATEGORIES

LPA Categories in the Philippines	IUCN Protected Area Management Categories
Strict Nature Reserve	Ia: Strict Nature Reserve Ib: Wilderness Area
Natural Park	II: National Park
Natural Monument	III: Natural Monument or Feature
Wildlife Sanctuary	IV: Habitat/Species Management Area
Protected Landscape/Seascape	V: Protected Landscape/Seascape
Natural Biotic Area	VI: Protected Area with Sustainable Use of Natural Resources

The Department of Environment and Natural Resources (DENR) is the primary implementing agency and administrator of the protected area system in the Philippines. Under the current ENIPAS implementation, there are a total of 244 protected areas, 72 of which are classified as MPAs and have a total coverage of 1.3 million hectares.[vii] The NIPAS/ENIPAS are complemented by the Wildlife Resources Conservation and Protection Act No. 9147 (the Wildlife Act), which further designates critical habitats.[viii] These are areas of known habitats of threatened species and fall outside the abovementioned protected areas under the NIPAS/ENIPAS.

For the purpose of this study, LPAs with coastal and marine components that fall under these two protected area categories—MPAs and critical habitats—have been screened and further described in the remainder of this section.

vi IUCN n.d.

vii BMB-DENR n.d.

viii Critical habitats are defined and designated by DENR according to their own set of criteria that are further detailed in Section 3.1.2. The term 'Critical Habitat' in this context does not refer to the IFC PS6 definition for critical habitat.

3.1.1 Coastal and marine protected areas

The Philippines is divided into three main island groups—Luzon, Visayas, and Mindanao—and 17 administrative regions, which encompass over 7,000 islands and a coastline of around 37,000 km. The Biodiversity Management Bureau (BMB) of the DENR implements a Coastal and Marine Ecosystem Management Program (CMEMP), which includes all coastal and marine areas of the Philippines covering 72 national MPAs under the NIPAS/ENIPAS and more than 1,600 LMPAs[ix] under the Fisheries Code (Republic Act No. 8550) and Local Government Code (Republic Act No. 7160). Based on the objectives of their establishment, MPAs in the Philippines are classified under four main categories:[x]

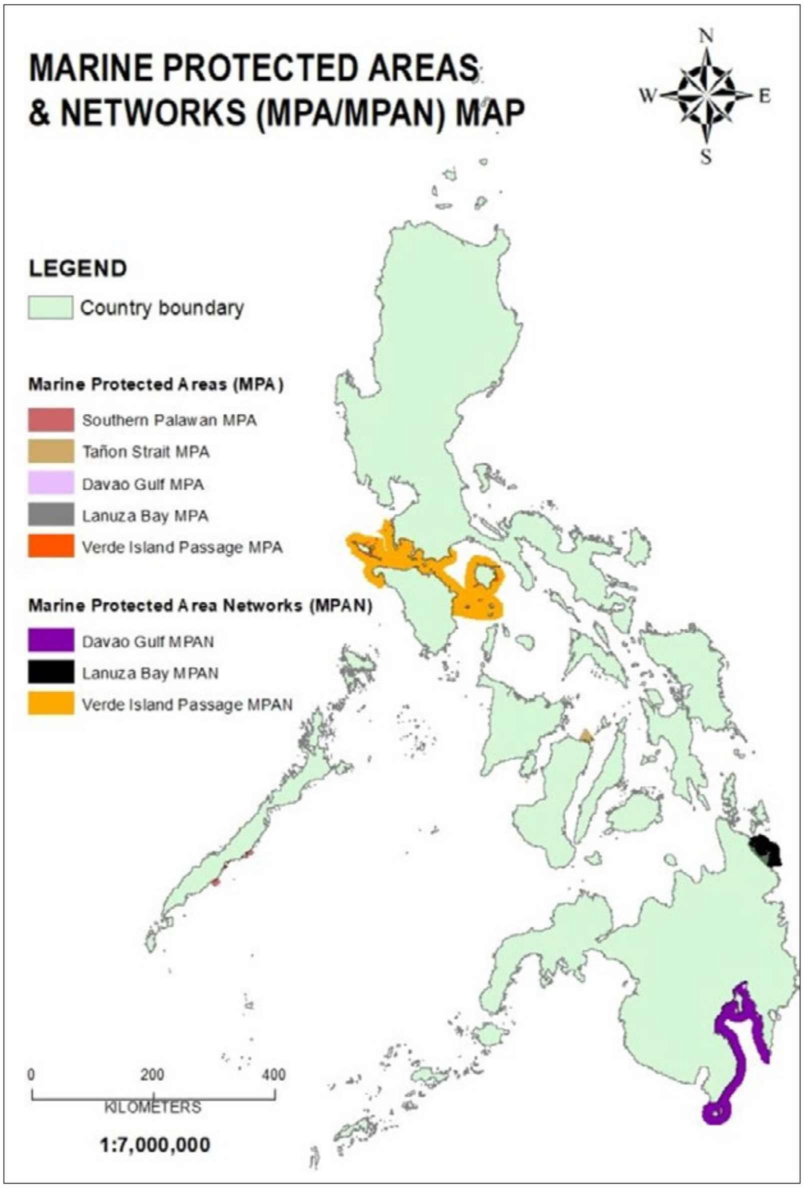
- Marine Sanctuary or no-take marine reserve, where all forms of extractive activities are prohibited
- Marine Reserve, where extractive and non-extractive activities are regulated
- Marine Park, where uses are designated into zones
- Protected Landscape and Seascape, where protection may include non-marine resources.

National MPAs are mostly referred to as 'MPAs under the NIPAS/ENIPAS' and include marine reserves, managed natural resource and protected areas, protected landscape and seascape, and wildlife sanctuaries. LMPAs that are designated by the Fisheries Code include fish reserves, sanctuaries and refuges; seagrass sanctuaries; marine parks; and marine reserves, sanctuaries, and refuges. LMPAs include all waters within a municipality that are not included in protected areas under the NIPAS Act.[xi] There is a mandate enforced by the House Bill No. 8145 to establish MPAs in all coastal municipalities and cities in the Philippines to ensure protection and preservation of marine resources and development of fisheries.

One of the components of the CMEMP is 'MPA Network Establishment and Strengthening'. The Philippines has three MPA Networks (MPANs): **Davao Gulf, Lanuza Bay, and Verde Island Passage** (FIGURE 1). MPANs have been identified to increase the effectiveness of coastal and marine ecosystem management, and the ability to provide ecological goods and services to improve the quality of life of coastal populations through combining LMPA resources.xii Establishment of MPANs is widely supported as networks fulfil conservation targets more effectively and comprehensively than individual MPAs, and enhance social and economic benefits through collaboration among local communities and management units.[xiii,xiv]

ix Ibid.
x BMB-DENR 2016.
xi BMB-DENR n.d.
xii Horigue et al. 2012.
xiii IUCN-WCPA 2007.
xiv UNEP-WCMC 2008.

FIGURE 1: MARINE PROTECTED AREA NETWORKS (MPANS) IN THE PHILIPPINES[XV]



BMB-DENR defines the main objectives of MPA establishment as biodiversity conservation, fisheries sustainability, tourism, and recreation.xvi It is unlikely that offshore wind development would be compatible with the biodiversity conservation objectives of MPAs under the NIPAS/ENIPAS. Although human activity is permitted in some of these protected areas, due to the likely sensitivity of threatened habitats and species to impacts associated with offshore wind development, they are included in the exclusion zone layer.

LMPAs under the Fisheries Code are included in the restriction zone layer due to lack of detailed spatial information on the distribution of their biodiversity values. Additional survey data are required to better assess whether offshore wind development is appropriate within a particular LMPA.

xv BMB-DENR n.d.

xvi BMB-DENR 2016.

3.1.2 Critical habitats

Critical habitats in the Philippines are designated on the basis of scientific data considering species endemism and/or richness and presence of anthropogenic threats to the survival of wildlife in the area. DENR regional or field offices facilitate establishment of critical habitats through their own initiative or upon a request from another concerned local government unit. The procedure for critical habitat establishment includes[xvii]

- Identification and validation of threatened species;
- Population estimate and rapid habitats assessment, community consultation, review and recommendation by DENR; and
- Declaration of areas as critical habitat by DENR and/or local government units and ground truthing.

Currently, there are nine declared critical habitats in the Philippines,[xviii] five of which have coastal and marine components as listed in Table 2, with qualifying threatened species identified for each. Critical habitats with coastal and marine components are included in the exclusion zone layer.

TABLE 2: CRITICAL HABITATS IN THE PHILIPPINES, DESIGNATED UNDER THE WILDLIFE ACT

No.	Critical Habitat	Area (ha)	Threatened Biodiversity
1	Cabusao Wetland Critical Habitat	27	*Anas luzonica* (Philippine Wild Duck; VU), *Numenius madagascariensis* (Far Eastern Curlew; EN), *Calidris tenuirostris* (Great Knot; EN), *Platalea minor* (Black-faced Spoonbill; EN), and *Egretta eulophotes* (Chinese Egret; VU)
2	Carmen Critical Habitat	5,756	Nesting grounds for *Eretmochelys imbricata* (Hawksbill Turtle; CR)
3	Adams Wildlife Critical Habitat[xix]	3,253	Last frontier of the dipterocarp forest in Ilocos Region
4	Magsaysay Critical Habitat for Hawksbill Turtles	613	Nesting grounds for *Eretmochelys imbricata* (Hawksbill Turtle; CR)
5	Dumaran Critical Habitat	1,628	*Cacatua haematuropygia* (Philippine Cockatoo; CR), *Siebenrockiella leytensis* (Philippine Pond Turtle; CR)

xvii DENR Administrative Order 2007-02, DENR 2007.

xviii BMB-DENR n.d.

xix Adams Wildlife Critical Habitat is divided into two sections, where only "Adams Wildlife Critical Habitat (Parcel 2)" extends into the northern coast of Luzon. The declared area includes both sections.

3.2 Key Biodiversity Areas

KBAs have been designated to cover the most important places in the world for species and their habitats. KBAs are identified using a global standard that includes criteria that were developed through a multi-stakeholder process. These criteria include quantitative thresholds that mean sites are globally important for the long-term survival of biodiversity. KBA identification is rigorous, transparent, and can be applied consistently in different countries and over time.

Sites qualify as KBAs if they meet one or more of eleven criteria, clustered into five higher-level categories: threatened biodiversity, geographically restricted biodiversity, ecological integrity, biological processes, and irreplaceability (KBA Criteria n.d).. The KBA criteria are broadly aligned with IFC PS6 criteria for critical habitat, although KBA criteria are wider, and therefore not all KBAs will qualify as critical habitat. All BirdLife International IBA are also classified as KBAs, although some would not meet the updated global KBA standard, and therefore might be treated as regional or national KBAs (see Section 3.2.1). All existing AZE sites are also KBAs (see Section 3.2.2).

The KBA identification process in the Philippines was undertaken in two phases. Terrestrial and freshwater KBAs (128) were designated in 2006, followed by identification of marine KBAs (123) in 2009, totalling up to 228 (with overlaps between marine and terrestrial/freshwater KBAs). Many of these KBAs were identified based on the 117 IBAs that had previously been identified by the BirdLife International and the Haribon Foundation (BirdLife Partner in the Philippines), as well as the 206 CPAs, which had been defined through the Philippine Biodiversity Conservation Priority-Setting Program.[xx]

The World Database of KBAs includes 139 of these KBAs that meet the global KBA standard, 37 of which are designated as marine KBAs. About 38 percent of the marine KBAs overlap with MPAs.[xxi,xxii] Table 3 provides a list of KBAs with their corresponding LPAs and other IRAs, where there are complete or partial overlaps. All the KBAs listed in the World Database in the Philippines with coastal and marine components are included in the exclusion zone layer.

xx BMB-DENR n.d.

xxi KBA 2021.

xxii IBAT n.d.

TABLE 3: KBAS IN THE PHILIPPINES WITH COASTAL AND MARINE COMPONENTS AND LPAS AND OTHER IRAS

KBA	Area (ha)	LPA (NIPAS/ E-NIPAS)	IUCN Category	Other LPA/IRA							
				Critical Habitat	IBA	AZE	Ramsar	EBSA	UNESCO Natural Heritage	UNESCO Biosphere Reserve	IMMA
Apo Reef Marine Natural Park KBA	25,557	Apo Reef Natural Park	II								
Babuyanes Islands KBA	809,775	—	—								
Balabac Island KBA	34,927	Palawan Game Refugee and Bird Sanctuary Entire Province of Palawan Mangrove Swamp Forest Reserve	—								
Bataan Natural Park and Subic Bay Forest Reserve KBA	25,181	Bataan Natural Park	II								
Batanes Island KBA	210,791	Batanes Protected Landscape and Seascape	V								
Buguey Wetlands KBA	10,873	—	—								
Busuanga Island KBA	94,692	Palawan Game Refugee and Bird Sanctuary Entire Province of Palawan Mangrove Swamp Forest Reserve	—								
Calauit Island KBA	3,640	Calauit Island Game Preserve and Wildlife Sanctuary	—								
Calituban and Tahong-tahong Islands (Talibon group) KBA	25,643	Talibon Group of Islands Protected Landscape and Seascape	V								
Catanduanes Watershed Forest Reserve KBA	62,747	Catanduanes Natural Park	II								

KBA	Area (ha)	LPA (NIPAS/ E-NIPAS)	IUCN Category	Other LPA/IRA							
				Critical Habitat	IBA	AZE	Ramsar	EBSA	UNESCO Natural Heritage	UNESCO Biosphere Reserve	IMMA
Coron Island KBA	7,788	Palawan Game Refugee and Bird Sanctuary Entire Province of Palawan Mangrove Swamp Forest Reserve	—								
Culion Island KBA	45,029	Palawan Game Refugee and Bird Sanctuary Entire Province of Palawan Mangrove Swamp Forest Reserve	—								
Dumaran Araceli KBA	30,017	Palawan Game Refugee and Bird Sanctuary Entire Province of Palawan Mangrove Swamp Forest Reserve	—								
El Nido KBA	91,753	El Nido Managed Resource Protected Area	IV								
Lalaguna Marsh KBA	3,139	—	—								
Malampaya Sound Protected Landscape and Seascape KBA	200,001	Malampaya Sound Protected Landscape and Seascape	V								
Mactan, Kalawisan and Cansaga Bays KBA	6,373										
Manila Bay	95,508	—	—								
North Eastern Cagayan Protected Landscape and Seascape KBA	227,586	Northern Sierra Madre Natural Park	II								
		Peñablanca Protected Landscape and Seascape	V								
Northern Sierra Madre Natural Park KBA	385,032	Northern Sierra Madre Natural Park	II								
Olango Island KBA	1,619	Olango Island Wildlife Sanctuary	V								

KBA	Area (ha)	LPA (NIPAS/ E-NIPAS)	IUCN Category	Other LPA/IRA							
				Critical Habitat	IBA	AZE	Ramsar	EBSA	UNESCO Natural Heritage	UNESCO Biosphere Reserve	IMMA
Pagbilao and Tayabas Bay KBA	2,697	Palsabangan River up to Magintuto River, Bacong River to Sandoval Point Mangrove Swamp Forest Reserve	—								
Peñablanca Protected Landscape and Seascape KBA	127,397	Peñablanca Protected Landscape and Seascape	V								
Polillo Islands KBA	20,285	Island of Polillo, Alabat, Cabelete, Jomalig, Patnanongan, Kalotkot, Kalongkooan, Palasan, Calabao, Icol and San Rafael Mangrove Swamp Forest Reserve	—								
Puerto Princesa Subterranean River Natural Park Cleopatra's Needle KBA	125,278	Puerto Princesa Natural Park Palawan Game Refugee and Bird Sanctuary Entire Province of Palawan Mangrove Swamp Forest Reserve	—								
Rasa Island KBA	1,019	Rasa Island Wildlife Sanctuary	IV								
Ragay Gulf KBA	20,417	Maulawin Spring Protected Landscape	V								
Romblon Island	8,553	—	—								
San Vicente-Taytay-Roxas Forests KBA	—	Palawan Game Refugee and Bird Sanctuary Entire Province of Palawan Mangrove Swamp Forest Reserve	—								
Siargo Island Protected Landscape and Seascape KBA	64,578	Siargo Island Protected Landscape and Seascape	V								

KBA	Area (ha)	LPA (NIPAS/ E-NIPAS)	IUCN Category	Other LPA/IRA							
				Critical Habitat	IBA	AZE	Ramsar	EBSA	UNESCO Natural Heritage	UNESCO Biosphere Reserve	IMMA
Sibutu and Tumindao Islands KBA	100,873	—	—								
Simunul and Manuk Manka Islands KBA	19,369	—	—								
South and North Gigante Island	2,251	—	—								
Tawi-tawi Island KBA	86,088	—	—								
Tubbataha Reef National Marine Park KBA	39,541	Tubbataha Reefs Natural Park	—								
Ursula Island KBA	1,148	Palawan Game Refugee and Bird Sanctuary Entire Province of Palawan Mangrove Swamp Forest Reserve	—								

3.2.1 Important bird and biodiversity areas

The BirdLife Global Seabird Programme has identified marine IBAs that include seabird breeding colonies, foraging areas around breeding colonies, non-breeding (usually coastal) concentrations, migratory bottlenecks, and feeding areas for pelagic species. The methodology for the designation of marine IBAs is described in the marine IBA toolkit.[xxiii]

The Philippines has two Marine IBAs: **Apo Reef Natural Park and Tubbataha Reef National Marine Park**. Both areas are also designated KBAs and LPAs and located within Sulu-Sulawesi Marine Ecoregion EBSA (see Section 3.5). Tubbataha Reef National Marine Park IBA is also a Ramsar Site (see Section 3.3), East Asian – Australasian Flyway (EEAF) Site, UNESCO Natural World Heritage Site, and UNESCO-MAB Reserve.

Apo Reef Natural Park Marine IBA has a variety of habitats including reefs, a small patch of mangroves, a stretch of sandy beach, and beach vegetation of coconut palms, scrub, and trees. The LPA is divided into three zones: the Strictly Protected Zone includes the coral sanctuary and the entire Apo Island and surrounding waters up to 500 meters from the shore; the Managed Reserve Zone comprises bird sanctuaries and Hawksbill and Green Turtle nesting grounds, where controlled human activities are allowed; and the Multiple-use Zone has recreation, anchorage, and fishing areas. The marine IBA is estimated to have 10,000 breeding pairs of seabirds.

Tubbataha Reef National Marine Park IBA is located in Central Sulu Sea and composed of North and South Atolls and the Jessie Beazley Reef. The most significant feature of the IBA is the North Atoll, which serves as a nesting ground for seabirds and two marine turtle species: Green Turtle and Hawksbill Turtle. It supports a few of the remaining colonies of breeding seabirds in the region. The mixed colonies include boobies, terns, egrets, and herons.[xxiv] There are also 600 fish species, 7 seagrass, and 13 shark species in these areas. Tubbataha Reefs is known to have the highest number of the Oceanic Whitetip Shark (*Carcharhinus longimanus*; CR) and supports threatened fish species like the Humphead Wrasse (*Cheilinus undulatus*; EN) and Giant Grouper (*Epinelphus lanceolatus*; VU).[xxv]

BirdLife has also identified EBAs, which are defined as areas that encompass the overlapping breeding ranges of restricted-range species, such that the complete ranges of two or more restricted-range species are entirely included within the boundary of the EBA.[xxvi] There are ten EBAs in the Philippines, five of which include IBAs with coastal and marine components: **Batanes and Babuyan Islands EBA, Luzon EBA, Mindanao and the Eastern Visayas EBA, Mindoro EBA**, and **Palawan EBA**. However, as most EBAs are too large to be protected as a whole; IBAs within each EBA stand as smaller areas that are more compatible with conservation objectives. Therefore, EBAs have not been included in either restricted or exclusion zones in their own right.

xxiii BirdLife International 2010.
xxiv BirdLife International 2021.
xxv Ramsar 2014.
xxvi BirdLife International 2021.

Table 4 provides a list of IBAs in the Philippines with coastal and marine components with associated threatened and restricted-range species and the EBAs they fall under. All IBAs with coastal and marine components are included in the exclusion zone layer.

TABLE 4: IBAS IN THE PHILIPPINES WITH COASTAL AND MARINE COMPONENTS

IBA	Threatened Species	EBA
Apo Reef Marine Natural Park	**Seabirds** - 10,000 breeding pairs. **Marine turtles** - *Eretmochelys imbricata, Chelonia mydas.*	—
Balabac Island	**Birds** - *Anthracoceros marchei, Cacatua haematuropygia, Ducula pickeringii, Prioniturus platenae, Ptilocichla falcata.* **Marine turtles** -*Eretmochelys imbricata.*	Palawan
Bataan Natural Park and Subic Bay	**Birds** - *Anas luzonica, Bubo philippensis, Cacatua haematuropygia, Erythrura viridifacies, Nisaetus philippensis, Prioniturus luconensis.* **Mammals** - *Acerodon jubatus.*	Luzon
Batanes Islands	**Birds** - *Egretta eulophotes, Emberiza sulphurate.* **Marine turtles** - *Eretmochelys imbricata, Chelonia mydas, Lepidocheyls olivacea.*	Batanes and Babuyan Islands
Buguey Wetlands	**Birds** - *Anas luzonica, Nisaetus philippensis*, Wintering and staging area for migratory waterfowl.	—
Busuanga Island	**Birds** - *Anthracoceros marchei, Cacatua haematuropygia, Ficedula platenae, Prioniturus platenae.* **Marine turtles** - *Eretmochelys imbricata, Chelonia mydas.*	Palawan
Calauit Island	**Birds** - *Anthracoceros marchei, Cacatua haematuropygia, Ducula pickeringii, Egretta eulophotes, Prioniturus platenae.*	Palawan
Calituban and Tahong-tahong Islands	**Birds** - *Egretta eulophotes*, Together with Olango Island and Mactan, Kalawisan and Cansaga Bays IBAs, supports the largest non-breeding population of the species.	—
Catanduanes Watershed Forest Reserve	**Birds** - *Anas luzonica, Ceyx melanurus, Cacatua haematuropygia.* **Marine turtles** - *Chelonia mydas, Lepidocheyls olivacea.*	Luzon
Culion Island	**Birds** - *Anthracoceros marchei, Cacatua haematuropygia, Ficedula platenae, Polyplectron napoleonis, Prioniturus platenae.*	Palawan
El Nido	**Birds** - *Anthracoceros marchei, Ducula pickeringii, Egretta eulophotes, Ficedula platenae, Polyplectron napoleonis.* **Marine turtles** - *Eretmochelys imbricata, Chelonia mydas, Lepidocheyls olivacea.*	Palawan
Lalaguna Marsh	**Birds** - *Anas luzonica.*	—
Mactan, Kalawisan and Cansaga Bays	**Birds** - *Egretta eulophotes.* Together with Olango Island and Calituban and Tahong-tahong Islands IBAs, supports the largest non-breeding population of the species. Important staging area for migratory shore birds – variety of herons and egrets.	—
Manila Bay	**Birds** - *Anas luzonica, Egretta eulophotes, Platalea minor, Thalasseus bernsteini.*	—
North Eastern Cagayan Protected Landscape and Seascape	**Birds** - *Anas luzonica, Bubo philippensis, Ceyx melanurus, Ducula carola, Hypothymis coelestis, Nisaetus philippensis, Oriolus isabellae, Pithecophaga jefferyi, Prioniturus luconensis, Ramphiculus marchei.*	Luzon

IBA	Threatened Species	EBA
Northern Sierra Madre Natural Park	**Birds** - *Bubo philippensis, Ceyx melanurus, Ducula carola, Erythrura viridifacies, Geokichla cinerea, Hypothymis coelestis, Muscicapa randi, Nisaetus philippensis, Oriolus isabellae, Pithecophaga jefferyi, Prioniturus luconensis, Ramphiculus marchei, Vauriella insignis.* **Marine turtles** - *Eretmochelys imbricata, Chelonia mydas.* **Mammals** - *Acerodon jubatus, Dugong dugon.*	Luzon
Olango Island	**Birds** - *Anas luzonica, Egretta eulophotes, Numenius madagascariensis.* Together with Mactan, Kalawisan and Cansaga Bays and Calituban and Tahong-tahong Islands IBAs, supports the largest non-breeding population of the Chinese Egret. Important staging area for migratory shorebirds – as many as 50,000 birds using the site.	—
Pagbilao and Tayabas Bay	**Birds** - *Anas luzonica, Ceyx melanurus, Egretta eulophotes, Pithecophaga jefferyi.* Important stating and wintering area for migratory herons, egrets and shorebirds.	—
Peñablanca Protected Landscape and Seascape	**Birds** - *Anas luzonica, Bubo philippensis, Ceyx melanurus, Ducula carola, Erythrura viridifacies, Geokichla cinerea, Hypothymis coelestis, Muscicapa randi, Nisaetus philippensis, Oriolus isabellae, Pithecophaga jefferyi, Prioniturus luconensis.* **Mammals** - *Acerodon jubatus.*	—
Polillo Islands	**Birds** - *Anas luzonica, Egretta eulophotes, Ceyx melanurus, Cacatua haematuropygia.* **Mammals** - *Dugong dugon.*	Luzon
Puerto Galera	**Birds** - *Gallicolumba platenae, Ducula mindorensis, Centropus steerii, Penelopides mindorensis, Cacatua haematuropygia, Geokichla cinerea.*	Mindoro
Puerto Princesa Subterranean River Natural Park Cleopatra's Needle	**Birds** -*Anthracoceros marchei, Cacatua haematuropygia, Egretta eulophotes, Ficedula platenae, Polyplectron napoleonis, Prioniturus platenae, Ptilocichla falcata, Tringa guttifer.*	Palawan
Ragay Gulf	**Birds** - *Egretta eulophotes.* Important area for migratory herons and shorebirds.	—
Siargao Island	**Birds** - *Cacatua haematuropygia, Otus gurneyi, Penelopides panini Sarcophanops steerii.*	Mindanao and the Eastern Visayas
Sibutu and Tumindao Islands	**Birds** - *Cacatua haematuropygia, Ducula pickeringii, Egretta eulophotes, Picoides ramsayi, Prioniturus verticalis.*	Sulu Archipelago
Simunul and Manuk Manka Islands	**Birds** - *Cacatua haematuropygia, Gallicolumba menagei, Prioniturus verticalis.*	Sulu Archipelago
Tawi-tawi Island	**Birds** - *Anthracoceros montani, Cacatua haematuropygia, Ducula pickeringii, Gallicolumba menagei, Hypothymis coelestis, Phapitreron cinereiceps, Picoides ramsayi, Prioniturus verticalis, Todiramphus winchelli.* **Marine turtles** - *Eretmochelys imbricata, Chelonia mydas, Dermochelys coriacea.* **Mammals** - *Dugong dugon.*	Sulu Archipelago
Tubbataha Reef	**Birds** - *Egretta eulophotes.* **Marine turtles** - *Eretmochelys imbricata, Chelonia mydas.* **Mammals** - *Physeter catodon.*	—
Ursula Island	**Birds** - *Ducula pickeringii, Otus mantananensis.* Shoreline is a migratory and wintering ground for shorebirds and the surrounding waters are important feeding grounds for seabirds, particularly terns.	Palawan

3.2.2 AZE sites

The AZE was established to designate and conserve the most important sites for global biodiversity. AZE engages governments, multilateral institutions, and nongovernmental biodiversity conservation organizations working to prevent species extinctions. There are 835 globally identified AZE sites, which are the areas that hold the last-remaining populations of one or more species evaluated as critically endangered or endangered by the IUCN Red List.[xxvii]

IFC Guidance Note 6 considers "sites that fit designation criteria for the AZE" not acceptable for financing with a possible exception of projects designed to contribute to the conservation of the area.[xxviii]

There are twelve AZE sites in the Philippines, three of which have coastal and marine components—**Culion Island, South and North Gigante Island**, and **Tawi-Tawi Island**. Table 5 provides a list of these sites with species that trigger designation of each. AZE sites are included in the exclusion zone layer.

TABLE 5: AZE SITES IN THE PHILIPPINES WITH COASTAL AND MARINE COMPONENTS

AZE Site	Trigger Species
Culion Island	Cycad (plant): *Cycas wadei* (Wade's Pitago; CR)
South and North Gigante Island	Amphibian: *Platymantis insulatus* (Island Forest Frog; CR)
Tawi-tawi Island	Birds: *Anthracoceros montani* (Sulu Hornbill; CR) *Gallicolumba menagei* (Sulu Bleeding-Heart; CR) *Phapitreron cinereiceps* (Dark-eared Brown Dove; EN) *Prioniturus verticalis* (Blue-winged Racket-tail; CR)

3.3 Ramsar sites

Ramsar sites are wetlands of international importance that have been designated under the criteria of the Ramsar Convention on Wetlands for containing representative, rare, or unique wetland types, or for their importance in conserving biological diversity. There are eight Ramsar sites in the Philippines, six of which have coastal and marine components:

- Las Piñas-Parañaque Critical Habitat and Ecotourism Area
- Negros Occidental Coastal Wetlands Conservation Area
- Olango Island Wildlife Sanctuary
- Puerto Princesa Subterranean River Natural Park
- Sasmuan Pampanga Coastal Wetlands
- Tubbataha Reefs Natural Park

Some of these areas are also designated as MPAs and critical habitats under the NIPAS and Wildlife Conservation Act, respectively, and some overlap with KBAs, IBAs, and EEAF sites, EBSAs, UNESCO-MAB Reserves, and UNESCO Natural World Heritage Sites. Table 6 summarizes these overlaps and Ramsar qualifying biodiversity.[xxix] All Ramsar sites are included the exclusion zone layer.

xxvii AZE n.d.
xxviii IFC 2019, GN55.
xxix Ramsar n.d.

TABLE 6: RAMSAR SITES IN THE PHILIPPINES WITH COASTAL AND MARINE COMPONENTS

Ramsar Site	Area (ha)	Protected Area		Priority Biodiversity
		LPA	IRA	
Las Piñas-Parañaque Critical Habitat and Ecotourism Area	174	Nature Reserve Critical Habitat	—	At least 5,000 individuals of migratory and resident birds have been recorded at the site, including about 47 migratory species such as the Chinese Egret (*Egretta eulophotes*; VU). The most important of the resident bird species is the endemic Philippine Duck (*Anas luzonica*; VU) which breeds at the site. Records during 2007–2011 show that the site supports at least 1% of the estimated population of Black-Winged Stilts (*Himantopus himantopus*) using the East Asian-Australasian Flyway.
Negros Occidental Coastal Wetlands Conservation Area	89,608	—	EEAF Site	72 waterbird species have been recorded at the site, including the Great Knot (*Calidris tenuirostris*; CR), Far Eastern Curlew (*Numenius madagascariensis*; EN), and Spotted Greenshank (*Tringa guttifer*; EN). There are three other vulnerable species: the Philippine duck (*Anas luzonica*), Chinese egret (*Egretta eulophotes*), and Java sparrow (*Lonchura oryzivora*). It is also known for its rich and diverse coastal resources, particularly mangroves and shellfish. The site hosts three threatened marine turtle species: Hawksbill Turtle (*Eretmochelys imbricata*; CR), Green Turtle (*Chelonia mydas*; EN), and Olive Ridley Turtle (*Lepidochelys olivacea*; VU). The Irrawaddy dolphin (*Orcaella brevirostris*; VU) also inhabits the coastal areas.
Olango Island Wildlife Sanctuary	5,900	Wildlife Sanctuary	KBA/IBA EEAF Site EBSA	One of the most important areas in the Philippines for migratory waterbirds providing habitat for staging, wintering, roosting, and feeding birds reaching 40,000 in number. There are 97 bird species in Olango, 48 of which are migratory, while others are residents. The most significant species in the area are the Asiatic Dowitcher (*Limnodromus semipamatus*; NT) and the Chinese Egret (*Egretta eulophotes*; VU).
Puerto Princesa Subterranean River Natural Park	22,202	Natural Park	KBA/IBA EBSA UNESCO Natural World Heritage Site	The site connects a range of important ecosystems including limestone karst landscape, cave system, mangrove forests, lowland tropical forests, and freshwater swamps. The site supports 15 endemic bird species including the Palawan Peacock Pheasant (*Polyplectron emphanum*; VU) and Tabon Scrub fowl (*Megapodius freycinet cumingii*), as well as the Philippine Cockatoo (*Cacatua haematuropygia*; CR), Nordmann's Greenshank (*Tringa guttifer*; EN), Hawksbill Turtle (*Eretmochelys imbricate*; CR), and Green Turtle (*Chelonia mydas*; EN).

Ramsar Site	Area (ha)	Protected Area		Priority Biodiversity
		LPA	IRA	
Sasmuan Pampanga Coastal Wetlands	96,828	Critical Habitat	KBA/IBA (part of Manila Bay)	Located on the island of Luzon in the north of the Philippine Archipelage, the site includes mudflats, mangroves, and riverine habitats serving as an important stopover point for migratory birds. In 2020, over 50,000 individuals were counted. Threatened species recorded at the site include the Spotted Greenshank (*Tringa guttifer*; EN), Black-faced Spoonbill (*Platalea minor*; EN), and Far Eastern Curlew (*Numenius madagascariensis*; EN). The site also hosts zones of the vulnerable mangrove species, Avicennia rumphiana, which along with more common Sonneratia alba provides shelter for juvenile fish, molluscs, and other marine and estuarine species.
Tubbataha Reefs Natural Park	96,828	Natural Park	KBA/IBA UNESCO Natural World Heritage Site UNESCO-MAB Biosphere Reserve	Islets of the natural park provide the only known breeding area for the endemic subspecies of the Black Noddy (*Anous minutus worcestri*) in the Philippines and provide breeding and feeding grounds for threatened species such as the Christmas Island Frigatebird (*Fregata andrewsi*; EN) as well as the Hawksbill Turtle (*Eretmochelys imbricata*; CR).

3.4 Important marine mammal areas

IMMAs are a joint project between the IUCN Species Survival Commission (SSC) and World Commission on Protected Areas (WCPA).[xxx] IMMAs are defined as discrete portions of habitat, important to marine mammal species that have the potential to be delineated and managed for conservation. IMMAs are designated using **standard criteria**:

- Criterion A - Species or Population Vulnerability: Areas containing habitat important for the survival and recovery of threatened and declining species.
- Criterion B - Distribution and Abundance (including small and resident populations, and aggregations).
- Criterion C - Key Life Cycle Activities (including reproduction, feeding and migration).
- Criterion D - Special Attributes (including distinctiveness and diversity).

The criteria have quantitative thresholds that are aligned with both IUCN standard for the identification of KBAs, and IFC PS6 criteria for Critical Habitat. Therefore, IMMAs should generally meet IUCN KBA and potentially IFC Critical Habitat criteria. There are five IMMAs in the Philippines: **Babuyan Marine Corridor, Bohol Sea, Iloilo and Guimaras Straits, Malampaya Sound**, and **Tañon Strait. Mayo Bay to Pujada Bay** is a candidate IMMA (cIMMA).[xxxi] IMMA qualifying criteria, species, and description of these areas are summarized in Table 7.

Babuyan Marine Corridor, Malampaya Sound, and Tañon Strait IMMAs are included in the exclusion zone layer, as all three areas overlap with LPAs and KBAs. Iloilo and Guimaras Straits IMMA is also included in the exclusion zone due to the presence of the Irrawaddy dolphin population. Mayo Bay to Pujada Bay cIMMA should also be considered once its assessment is completed and spatial boundaries are determined.

xxx IUCN-MMPATF 2019.

xxxi IUCN-MMPATF n.d.

TABLE 7: IMMAS IN THE PHILIPPINES

IMMA	Area (ha)	Primary Species	IMMA Criteria[xxxii]	Additional Species - (IMMA Criterion D (ii) Diversity)	Description
Babuyan Marine Corridor	1,689,300	*Megaptera novaeangliae* (Humpback whale)	Criterion A; C (1)	*Physeter macrocephalus, Globicephala macrorhynchus, Pseudorca crassidens, Feresa attenuata, Peponocephala electra, Kogia sima, Stenella attenuata, Stenella longirostris, Tursiops truncatus, Grampus griseus, Lagenodelphis hosei*	Babuyan Islands and surrounding waters are the only known wintering/breeding populations of the Humpback whale in the Philippines. There is also a small resident population of the Rough-toothed dolphin. Babuyanes Islands is also a marine KBA supporting 11 other cetacean species, as well as whale sharks, marine turtles, fish, and corals.
		Steno bredanensis (Rough-toothed dolphin)	Criterion B (1); C (2)		
Bohol Sea	2,951,700	*Physeter macrocephalus* (Sperm whale)	Criterion A Criterion A Criterion B (2) Criterion B (2)	*Balaenoptera edeni, Balaenoptera omurai, Feresa attenuata, Grampus griseus, Globicephala macrorhynchus, Kogia sima, Kogia breviceps, Mesoplodon densirostris, Orcinus orca, Pseudorca crassidens, Stenella attenuata, Stenella longirostris longirostris, Stenella longirostris roseiventris, Steno bredanensis, Tursiops truncatus*	Bohol Sea represents a hotspot for the cetaceans in the Philippines and South East Asia, where 19 species are known to occur. It is the only known area in the Philippines where the Blue whale has been identified. There are also records of Sperm whale, Bryde's whale, and Omura's whale. Deeper waters support resident populations of Melon-headed whale, Short-finned Pilot whale, Risso's dolphin, and Fraser's dolphin.
		Balaenoptera musculus (Blue whale)			
		Peponocephala electra (Melon-headed whale)			
		Lagenodelphis hosei (Fraser's dolphin)			
Iloilo and Guimaras Straits	34,000	*Orcaella brevirostris* (Irrawaddy dolphin)	Criterion A; B (1)	*Tursiops aduncus, Grampus griseus, Pseudorca crassidens, Kogia sima, Stenella attenuata, Dugong dugon, Globicephala macrorhynchus*	This IMMA hosts one of the three subpopulations of Irrawaddy dolphin, represented by an estimated number of 30 individuals.

xxxii IUCN-MMPATF 2021

IMMA	Area (ha)	Primary Species	IMMA Criteria[xxxii]	Additional Species - (IMMA Criterion D (ii) Diversity)	Description
Malampaya Sound	19,700	*Orcaella brevirostris* (Irrawaddy dolphin)	Criterion A; B (1); D (1)	*Tursiops truncates*	Malampaya Sound in Palawan hosts a locally occurring subpopulation of the Irrawaddy dolphin, which is estimated to be around 35 individuals. It is also a designated LPA and KBA.
Tañon Strait	537,100	*Tursiops aduncus* (Indo-Pacific Bottlenose dolphin)	Criterion B (1); C (2)	*Tursiops aduncus, Stenella longirostris, Grampus griseus, Globicephala macrorhynchus, Kogia sima, Peponocephala electra, Pseudorca crassidens, Stenella attenuata*	Tañon Strait is a Protected Seascape, where all cetaceans are under full protection by local and national law. The area is significant for resident Indo-Pacific Bottlenose and Spinner dolphins, as well as high cetacean diversity.
		Stenella longirostris (Spinner dolphin)	Criterion C (2, 3)		
Mayo Bay to Pujada Bay (cIMMA)	—	*Dugong dugon* (*Dugong*)	Unconfirmed – pending assessment	Detailed information will be available when full IMMA status is granted.	The candidate IMMA encompasses two neighboring bays separated by the Guanguan Peninsula. Pujada Bay is rich in its coral reef system. The area has 850 hectares of mangroves and 9 of the 16 seagrass species in the Philippines occur here. IUCN-MMPATF reports good Dugong feeding activity in the area.

3.5 Ecologically or biologically significant areas

EBSAs are special areas in the ocean that support the healthy functioning of oceans and the many services that they provide. The Conference of the Parties (COP 9) to the Convention on Biological Diversity adopted the following seven scientific criteria for identifying EBSAs: Uniqueness or rarity; Special importance for life history stages of species; Importance for threatened, endangered, or declining species and/or habitats; Vulnerability, fragility, sensitivity, or slow recovery; Biological productivity; Biological diversity; and Naturalness. The identification of EBSAs and the selection of conservation and management measures is a matter for states and competent intergovernmental organizations (IGOs), in accordance with international law (including the UN Convention on the Law of the Sea). The criteria do not include quantitative thresholds, but in principle they have a lot in common with WBG/IFC natural habitats definition and IFC critical habitat criteria and could therefore constitute an important high-level planning consideration for offshore wind development.

The SSME EBSA is located at the apex of the Coral Triangle Region. It covers 100,352,600 hectares and includes multiple marine areas within the Philippine EEZ. The SSME is home to coral reefs, seagrass meadows, and mangrove forests that support a range of fish, marine turtle, dolphin, whale, shark, and ray species, as well as other less well-known marine flora and fauna. The largest and almost intact mangrove forests are found in Palawan and Mindanao. Seagrass beds are found throughout the SSME providing important feeding grounds for marine turtles and dugongs. All types of corals can be found in the SSME, where the most common are the patch and fringing reefs that are found along the coastline of islands.[xxxiii]

In the Philippine EEZ, in addition to several undefined marine areas, the SSME EBSA encompasses LPAs and IRAs that are listed in Table 8. Due to the large spatial extent of the EBSA and lack of detailed spatial information on the distribution of its biodiversity values, marine areas of the EBSA that are not already included in the exclusion zone layer because of overlap with LPAs and KBAs are included in the restriction zone layer. However, additional survey data are required to better assess whether offshore wind development is appropriate within the EBSA.

xxxiii CBD 2017.

TABLE 8: PROTECTED AREAS WITHIN THE SULU-SULAWESI MARINE ECOREGION EBSA

No.	Protected Area	LPA	IRA
1	Apo Reef Marine Natural Park		
2	Asid Gulf Marine Protected Area Network (AGMPAN)		
3	Balabac Island		
4	Busuanga Island		
5	Calauit Island		
6	Calituban and Tahong-tahong Islands (Talibon group)		
7	Carmen Critical Habitat		
8	DENR Antique, BFAR Antique, Office of the Provincial Agriculture (OPA) Antique and Rare Inc.		
9	Dumaguete City, Negros Oriental		
10	Dumaran Araceli		
11	Hinatuan Passage Development Alliance (HIPADA)		
12	Initao-Libertad Protected Landscape and Seascape		
13	Island of Sta Cruz and Salomague, foreshoreline of dapdap and alabo to the mouth of tagum river, malinoa creek to salomague point, foreshoreline of Barrio Cabuyagan to eastern side of Dating Bayan River in Calancan Bay Mangrove Swamp Forest Reserve		
14	Magsaysay Critical Habitat		
15	Olango Island		
16	Palawan Game Refuge and Bird Sanctuary & Entire Province of Palawan Mangrove Swamp Forest Reserve that does not overlap with KBAs (including islands)		
17	Puerto Princesa Subterranean River Natural Park Cleopatra's Needle		
18	Ragay Gulf		
19	Sagay Marine Reserve		
20	San Juan Siquijor		
21	Siargo Island Protected Landscape and Seascape		
22	Sibutu and Tumindao Islands		
23	Simunul and Manuk Manka Islands		
24	South and North Gigante Island		
25	Tañon Strait Protected Seascape		
26	Tawi-tawi Islands		
27	Ticao-Burias Pass Protected Seascape		
28	Tubbataha Reef National Marine Park		
29	Ursula Island		

3.6 UNESCO World Heritage Natural Sites

The Convention concerning the Protection of the World Cultural and Natural Heritage adopted by UNESCO in 1972 embodies designation of World Heritage Sites for having outstanding universal value to humanity. States Parties to the Convention identify and nominate suitable sites of cultural and/or natural heritage sites to the World Heritage Committee, which is the main body in charge of implementation of the Convention. In line with UNESCO's World Heritage Mission to help States Parties safeguard World Heritage properties, Operational Guidelines[xxxiv] for the Implementation of the Convention sets forth procedures for:

- Inscription of properties on the World Heritage List and the List of World Heritage in Danger;
- Protection and conservation of World Heritage properties;
- Grating of International Assistance under the World Heritage Fund; and
- Mobilization of national and international support in favour of the Convention.

Article 4 of the Convention states that each State Party "recognizes that the duty of ensuring the identification, protection, conservation, presentation and transmission to future generations of cultural and natural heritage situated on its territory, belongs primarily to that State."[xxxv] The Philippines has three natural heritage sites, two of which have coastal and marine components: **Puerto Princesa Subterranean River Natural Park** and **Tubbataha Reefs Natural Park**.

Puerto Princesa Subterranean River Natural Park is located in Palawan, comprising an area of approximately 22,202 hectares and containing an 8.2 km long underground section of Cabaguyan River that flows directly into the sea. The site encompasses a distinctive cave system with limestone karst formations, mangrove and tropical forests, and a range of endemic species.

Tubbataha Reefs Natural Park has a unique location in the center of the Sulu Sea with near pristine coral reefs of at least 359 coral species. The site protects almost 100,000 hectares of marine habitats with a large area of deep sea and has a great diversity of whales, dolphins, sharks, marine turtles, and over 600 fish species including the Humphead Wrasse.[xxxvi]

Both sites are designated national parks (under NIPAS), KBAs (Table 3), IBAs (Table 4), Ramsar Sites (Table 6), and they both fall within the Sulu-Sulawesi Marine Ecoregion EBSA (see Table 8). Tubbataha Reefs Natural Park is also protected as a UNESCO-MAB Reserve (see Section 3.7) and under the Tubbataha Act (Republic Act No. 10067).

Another six sites with coastal and marine components are on the tentative list submitted by the Philippines to the World Heritage Committee, on the basis of on an initial inventory of natural and cultural heritage sites located within its boundaries:

xxxiv UNESCO World Heritage Centre 2019.

xxxv Convention concerning the Protection of the World Cultural and Natural Heritage 1972.

xxxvi UNESCO World Heritage Centre n.d.

- Apo Reef Natural Park
- Batanes Protected Landscapes and Seascapes
- Coron Island Natural Biotic Area
- El Nido-Taytay Managed Resource Protected Area
- Northern Sierra Madre Natural Park and outlying areas inclusive of the buffer zone
- Turtle Islands Wildlife Sanctuary.

All of these sites are designated LPAs and IRAs, except for Turtle Island Wildlife Sanctuary, which is not a designated KBA but is protected under the NIPAS Act.

IFC Guidance Note 6 prohibits development in UNESCO World Heritage Sites. The two World Natural Heritage Sites in the Philippines—Puerto Princesa Subterranean River Natural Park and Tubbataha Reefs Natural Park—and the six sites on the tentative list are thus included in the exclusion zone layer.

3.7 UNESCO-MAB Biosphere Reserves

As approved by UNESCO in 1995, the Statutory Framework for the World Network of Biosphere Reserves is a 'soft legal framework' for development and recognition of biosphere reserves, which can be proposed by all members and associate members. UNESCO MAB Programme is an intergovernmental programme combining natural and social sciences to improve human livelihoods and safeguard natural and managed ecosystems. Biosphere reserves are nominated by national governments and designated under the MAB program, which provides support in national planning and implementation of research and training programs with technical assistance and scientific advice. These sites are internationally recognized.

The Philippines has three biosphere reserves, two of which have coastal and marine components: **Puerto Galera** and **Palawan**. Puerto Galera Biosphere Reserve is located on Mindoro Island covering 23,300 hectares. It is composed of savannas and grasslands, dipterocarp forests, mossy forests, coral reefs, and coastal ecosystems. Coral reef conservation is one of the main tasks defined for the reserve, where maintenance of traditional livelihoods, culture, and tourism is also targeted.[xxxvii] Puerto Galera Biosphere Reserve and Puerto Galera KBA/IBA overlap for the most part, but the latter does not extend to the northern tip of Mindoro Island to include coastal and marine components.

Palawan Biosphere Reserve includes the entire Province of Palawan Island covering 1,150,800 hectares. Palawan is an archipelago that is composed of a main island and more than 1,700 smaller islands. Of the 475 threatened species identified in the Philippines, 105 are found in Palawan. There are 379 coral, 13 seagrass, and 31 mangrove species. The biosphere reserve has some of the highest remaining mangrove cover in the Philippines. The entire province of Palawan has two LPA statuses: Game Refuge and Bird Sanctuary (and the small island of Palawan is a National Reserve)[xxxviii] and Mangrove Swamp Forest Reserve.[xxxix] Palawan also includes KBAs and IBAs with coastal and marine components that are listed in Table 3 and Table 4, respectively.

UNESCO-MAB Reserves of Puerto Galera and Palawan are included in the exclusion zone layer.

xxxvii UNESCO 2018a, 2018b.
xxxviii Under Proclamation No. 219.
xxxix Under Proclamation No. 2152.

4. NATURAL HABITATS

The Philippines has several coastal and marine ecosystems that are highly important, both ecologically and economically, for the country. Although the Philippines has no official list of threatened natural habitats, for the purpose of this report, the three threatened natural habitats that are discussed in this section are coral reefs, seagrass beds, and mangrove forests.[xl]

Coral Reefs: The estimated coral reef area of the Philippines is around 26,000 km^2, which is the third largest in the world after Indonesia and Australia. There are approximately 500 scleractinian corals, of which almost 200 are threatened, and 12 are endemic. Coral reefs are home to more than 1,700 reef fish, as well as the five threatened marine turtle species. Coral reefs also provide livelihood to nearly half of the Philippines' population.[xli,xlii] Apo Reef is the largest coral reef in the Philippines, and the second-largest contiguous coral reef in the world after Australia's Great Barrier Reef. The National Assessment of Coral Reef Environment Ecosystems (NACRE) Program data from 2014 to 2017 identify the status of coral reefs at 206 stations within the three main island groups, Luzon, Visayas, and Mindanao, across the six biogeographic regions of the country. Accordingly, the Sulu Sea has the highest hard coral cover (HCC) with a percentage of 28.4% ± 2.4%, followed by the West Philippine Sea and Celebes Sea, with 26.0% ± 1.6% and 23.6% ± 3.7%, respectively. The Sulu and West Philippine Seas also hold the highest coral generic diversity (TAU).[xliii,xliv]

MPAs and LMPAs under the NIPAS/ENIPAS are estimated to protect 2.7–3.4 percent of the total coral reef area in the Philippines.[xlv] More than 40 million hectares of coral reefs are estimated to lie within KBAs, mostly (60 percent) in the West Philippine Sea, with a significant concentration around the Kalayaan Islands Group.[xlvi]

The mapped areas of coral reef sourced from the Allen Coral Atlas[xlvii] are included in the exclusion zone layer. Threatened invertebrates and reef-associated fish species are also covered by these areas.

Seagrass Beds: Seagrass beds support biodiversity and important ecological functions, providing food, shelter, and nursery areas to juvenile and small adult fish, invertebrates, marine turtles, and the dugong in the Philippine EEZ. They act as a buffer protecting the shoreline and support adjacent coral reefs and mangroves by stabilizing the sea bottom. Seagrass beds are also important for coastal livelihoods due to the support they provide to fisheries and tourism. More recently, seagrasses have been recognized as a 'blue carbon' ecosystem as they sequester high amounts of carbon from the atmosphere.[xlviii,xlix,l]

xl There are several components of national legislation that address the conservation and management of marine habitats and associated biodiversity.

xli BMB-DENR 2019.

xlii ADB 2014.

xliii BMB-DENR 2019.

xliv Licuanan, Robles, and Reye 2019.

xlv Weeks et al. 2010.

xlvi ADB 2014.

xlvii ASU 2021.

xlviii Fortes 2018.

xlix Du et al. 2020.

l ADB 2014.

The Philippines has the highest seagrass diversity in Southeast Asia with 18 species found at 529 sites, distributed throughout the country from Bolinao Bay in the north, Palawan and the Cebu-Bohol-Siquijor area in the center, and Zamboanga and Davao in the south. *Halophila beccarii* (Ocean Turf Grass), assessed as Vulnerable according to the IUCN Red List, is the only threatened seagrass species. The Philippines also has the largest extent of seagrass beds in Southeast Asia. Most of the studies are from Northwest Luzon. The Eastern Philippine Ecoregion, which encompasses Luzon (excluding Palawan), Visayas, and Mindanao Islands has 11 species within an area of approximately 715 hectares[li] Due to their importance for the ecosystem and threatened marine species, the mapped areas of seagrass beds sourced from the Allen Coral Atlas[lii] are included in the exclusion zone.

Mangroves: Coastal mangrove forests grow in the intertidal zone of tropical and subtropical regions and play a crucial role in protecting the shoreline from erosion and tropical storms. They not only provide nursery and feeding areas for threatened marine species (including cetaceans, dugong, marine turtles, and cartilaginous fish) but mangroves also offer important ecosystem services to coastal communities.[liii,liv,lv]

Mangrove forest cover in the Philippines is reported to have increased from 247,362 hectares in 2003 to 310,531 hectares in 2010, but decreased to 303,402 hectares in 2015.[lvi] The Province of Palawan has the largest extent of mangroves with 63,532 hectares, where 4.4 percent of the province's total land area comprises 46 percent of the total mangrove forest area in the country. Provinces of Sulu, Quexzon, Zamboanga Sibugay, Surigao del Norte, Tawi-Tawi, Samar, Zangoanga del Sur, Bohol, and Basilan have the major mangrove areas.

Twenty percent of the Philippines' mangroves lie within LPAs that correspond to IUCN protected area categories I–VI, the majority of which are located in Palawan and Siargao. The Mangrove and Beach Forest Development Project (MBFDP) is one of the components of the National Greening Program (NGP) run by the Philippine Government and has been implemented at disaster-affected areas and targets sites in almost all regions of the country.[lvii,lviii] The mapped areas of mangroves sourced from Clarks Labslix are included in the exclusion zone.

Table 11 provides additional sources of information in relation to threatened marine habitats that could be useful to inform MSP, site selection, and ESIA.

li Fortes et al. 2018.
lii ASU 2021.
liii Primavera 2004.
liv Long and Giri 2011.
lv ADB 2014.
lvi BMB-DENR 2019.
lvii PCSD 2015.
lviii Long and Giri 2011.
lix Clarks Lab, Clarks University 2021.

5. CARTILAGINOUS FISH

The Philippines has at least 164 species of sharks, rays, and chimaeras that belong to 45 families. The presence of 96 species has been confirmed on vouchers specimens, photos, or other validated data, while 26 species require additional confirmation and 40 have been identified as new and potentially endemic to the Philippines.[lx]

The National Stock Assessment Program (NSAP) under the Department of Agriculture Bureau of Fisheries and Aquatic Resources (BFAR) has been conducting shark and ray assessments in different administrative regions. The Sharks Assessment Report (SAR) dataset for 2009–2016 has records of 180 shark and ray species with landings in all administrative regions of the Philippines, except for Region 9 Zamboanga Peninsula. The highest number of species was recorded in Region 6 Western Visayas, 45 shark, and 36 ray species, followed by Region 7 Central Visayas and Region 1 Ilocos.

The most prevalent cartilaginous species include threatened *Carcharhinus melanopterus* (Blacktip Reef Shark; VU), *Sphyrna lewin*i (Scalloped Hammerhead; CR), *Alopias pelagicus* (Pelagic Thresher; EN), *Carcharhinus albimarginatus* (Silvertip Shark; VU), *Carcharhinus falciformis* (Silky Shark; VU), *Manta birostris* (Giant Manta Ray; EN), and *Himantura uarnak* (Coach Whipray; VU). Of the top 16 most prevalent species, 75 percent are pelagic, including carcharhinid sharks, sphyrnids, threshers, and even mantas and eagle rays, while about 25 percent are demersal stingrays and bamboosharks.[lxi] A full list of the identified threatened species is provided in Table 10.

Priority conservation areas (PCAs) for Rhincodon typus (whale shark; EN) and other elasmobranchs were identified in 2001 by the Philippine Biodiversity Conservation Priority-Setting Program. The baseline studies were conducted in Donsol, Sorsogon, Honda Bay, Puerto Princesa, Zambales, Mati, Davao, Bohol Sea and Sogod Bay, and Leyte, which resulted in identification of 12 PCAS for whale sharks based on important aggregation sites and feeding grounds for the species. Due to lack of fishery-independent data on other elasmobranchs, PCAs were based on historical shark fisheries information on West Sulu Sea, Lamon Bay, Babuyan Channel, and Cuyo Pass in Luzon, Visayan Sea, East Sulu Sea, Guimaras Strait, Sibuyan Sea, South Sulu Sea, and Moro Gulf (FIGURE 2).

At least 24 threatened elasmobranchs were considered as trigger species during the marine KBA identification process in the Philippines, which led to the designation of six KBAs (see Section 3.2). Pujada Bay Protected Landscape and Seascape, Cagayancillo MPA, Donsol Marine Conservation Park, Malapascua MPA, and a number of other LMPAs to conserve cartilaginous fish among other threatened habitats and species.[lxii]

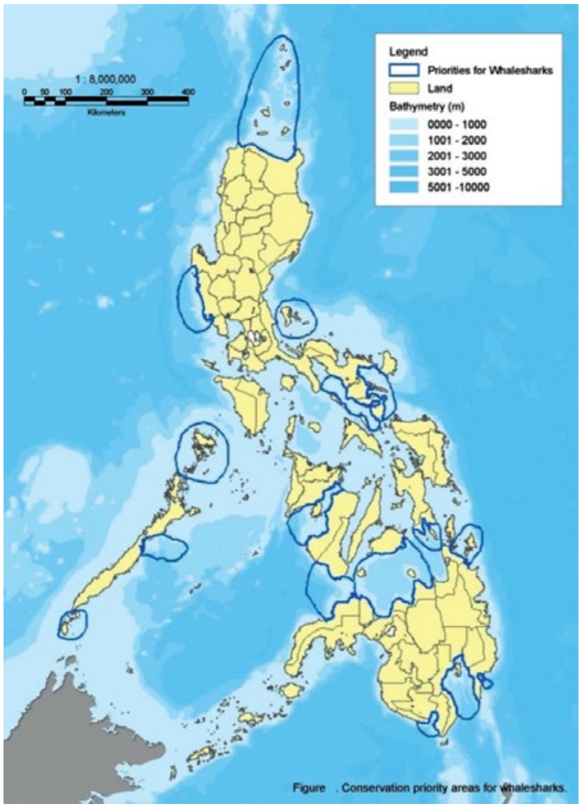
KBAs and MPAs significant for sharks, rays, and chimaeras are included in the exclusion zone layer. No additional digitized spatial datasets were found for cartilaginous fish, but there are survey and sighting data available that could be useful to inform MSP, site selection, and ESIA as listed in Table 11.

lx BFAR-NFRDI 2017.

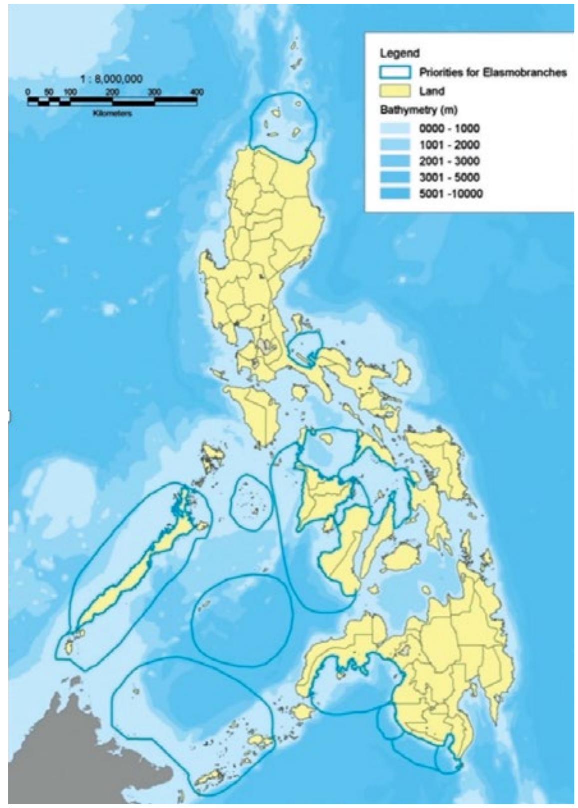
lxi Ibid.

lxii Ibid.

FIGURE 2: PRIORITY CONSERVATION AREAS FOR THE WHALE SHARK AND OTHER ELASMOBRANCH IN THE PHILIPPINES



Whale Shark Priority Conservation Areas



Elasmobranch Priority Conservation Areas

6. MARINE TURTLES

The Philippines is home to five of the seven marine turtles in the world, all of which are threatened species: *Chelonia mydas* (Green Turtle; EN), *Eretmochelys imbricata* (Hawksbill Turtle; CR), *Lepidochelys olivacea* (Olive Ridley Turtle; VU), *Demochelys coriacea* (Leatherback Turtle; CR), and *Caretta caretta* (Loggerhead Turtle; VU) (Table 10).

The Green, Hawksbill, and Olive Ridley Turtles are widely distributed throughout the country. The Green Turtle nests in the Turtle and San Miguel Islands in Tawi-Tawi, Pitogo, Zamboanga del Sur, and two islands in Basilan—Languil and Malamawi. The Hawksbill only nests in Lagonoy Gulf. Olive Ridleys have been sighted all over the country with nesting sites in Subic Bay Freeport Zone, Morong, Bataan, Lian and San Juan, Batangas, and Puerto Princesa City. The Leatherback nests mostly in Malaysia and Indonesia and forages in the Philippines around Palawan, Central Visayas, Bicol, and the Davao Gulf. The first nesting Leatherback was recorded in 2013 in Barangay Rawis in Bicol Region. The Loggerhead nests in Japan and forages in waters of Basilan and Bicol Region of the Philippines. It has no nesting records.[lxiii,lxiv]

lxiii MWWP 2014.

lxiv Miclat and Arceo 2018.

The majority of these nesting sites are designated LPAs and IRAs. Turtle Island Wildlife Sanctuary and Tubbataha Reef National Marine Park are two of the most important LPAs for marine turtles. Section 3 identifies LPAs that have known nesting and foraging sites of marine turtles (Critical Habitats [Table 2], IBAs [Table 4], Ramsar Sites [Table 6], Babuyan Marine Corridor IMMA [Table 7]), all of which are included in the exclusion zone layer. No additional digitized spatial data have been identified in relation to marine turtles; however, Table 11 provides additional sources of survey and nesting data in relation to marine fish that could be useful to inform MSP, site selection, and ESIA.

7. BIRDS

7.1 Threatened Species

There are 18 threatened waterbird species whose IUCN global ranges overlap with the Philippine EEZ (Table 10). LPAs and IRAs that are important for threatened species are described in Section 3, all of which are included in the exclusion zone layer. Some of the other important coastal wetlands include Balayan Bay, Cabulao Bay, Caramoan Peninsula, Inabanga Coast, Panguil Bay, Talabong Island and Bais Bay, Turtle Island, and Ulugan Bay.[lxv] No additional digitized spatial data were found in relation to threatened bird species; however, Table 11 provides additional sources of survey data that could be useful to inform MSP, site selection, and ESIA.

7.2 Migratory Waterbird Flyways

Migratory marine birds are at risk of collision with turbines, barrier effects, and displacement due to offshore wind farms. Both inland and coastal wetlands of the Philippines are part of the EAAFP and are being monitored annually through the AWC at AWC sites throughout the country. During the AWC 2014–2017 monitoring period, based on an informal classification by BMB-DENR, migratory waterbird groups with the highest number of recorded species and highest population counts were shorebirds and waders; herons and egrets; geese and ducks; rails, gallinules, and coots; and gulls, terns, and skimmers.[lxvi]

The EAAF Partnership also identifies internationally important sites within the flyway to ensure long-term survival of migratory waterbirds. The Philippines has three EAAF sites with coastal and marine components:[lxvii] Olango Island Wildlife Sanctuary, Tubbataha Reefs Natural Park, and Negros Occidental Coastal Wetlands Conservation Area, all of which are designated MPAs, KBAs, and Ramsar Sites. Section 3 provides information on other protected areas that are significant for migratory waterbirds and therefore included in the exclusion zone layer.

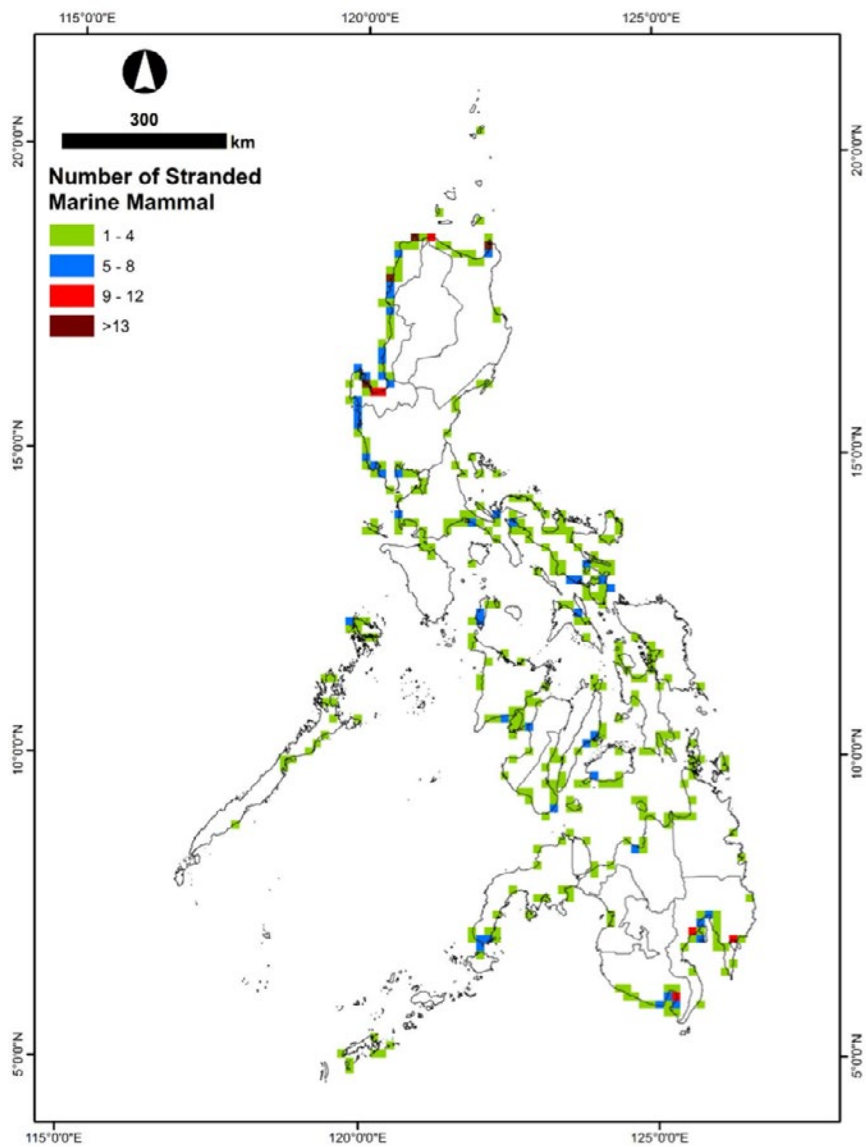
No additional digitized spatial data were found in relation to migratory waterbird species; however, Table 11 provides additional sources of bird survey and modelling data that could be useful to inform MSP, site selection, and ESIA.

lxv ADB 2014.
lxvi BMB-DENR 2019.
lxvii EAAFP 2018.

8. MARINE MAMMALS

There are 29 confirmed marine mammal species in the Philippines: 28 cetaceans, of which five are threatened species (Table 10) and 1 sirenian—*Dugong dugon* (dugong; VU). During the annual surveys in 2005–2018 led by the Philippine Marine Mammal Stranding Network (PMMSN), 952 strandings of 27 species were recorded in all regions of the Philippines with a coastline. Most of these (60 percent) occurred in Luzon, while Visayas and Mindanao had an equal share of 20 percent each. FIGURE 3 shows the number of strandings based on 2005–2018 data points.[lxviii,lxix]

FIGURE 3: MARINE MAMMAL STRANDINGS IN THE PHILIPPINES (2005–2018, BASED ON 15 X 15 KM GRIDS CREATED FOR EACH MUNICIPALITY/CITY COASTLINE)



lxviii Aragones, Laggui, and Amor 2017.

lxix Aragones and Laggui 2019.

Physeter macrocephalus (Sperm whale; VU) is found in almost all major seas of the Philippines but sightings are mostly of solitary animals. There are only a few records of sightings of more than two animals.[lxx] *Orcaella brevirostris* (Irrawaddy dolphin; EN) has a single known population in Malampaya Sound in Palawan.[lxxi] Dugongs are mostly found around the southern and western Mindanao Coast, Guimaras Strait and Antique, Aurora, Quezon and the Polillo Island, Tawi-Tawi, and Sulu Archipelago. Between 2010 and 2019, there were 23 sightings of *Balaenoptera musculus* (Blue whale; EN) in the Bohol Sea around Pamilacan Island, Panglao Island, Sogod Bay, and Oslob.[lxxii]

IRAs that are significant for marine mammals are described Section 3 (IBAs, Table 4; and IMMA, Table 7). Most coasts where there are marine mammal records are also designated MPAs and are therefore included in the exclusion zone layer. No additional digitized spatial data were found in relation to marine mammals; however, Table 11 provides additional sources of sighting and stranding data that could be useful to inform MSP, site selection, and ESIA.

9. SUMMARY

Sections 3 to 8 provide the rationale for the digitized spatial data included within the Exclusion and Restriction zone layers, to be taken into account within the Philippine offshore wind roadmap. These are summarized in Table 9 along with the sources of the relevant digitized spatial data.

TABLE 9: SUMMARY TABLE OF DIGITIZED SPATIAL DATA TO BE INCLUDED IN EXCLUSION AND RESTRICTION ZONE LAYERS

Zone	Priority Biodiversity Value	Available Digitized Spatial Data Layer	Source
Exclusion Zone	LPAs and IRAs	MPAs under the NIPAS/ENIPAS	
		Critical Habitats	BMB-DENR
		KBAs, including IBAs and AZE Sites	www.ibat-alliance.org
		Ramsar Sites	http://www.ibat-alliance.org
		IMMAs	http://www.marinemammalhabitat.org
		UNESCO World Heritage Natural Sites	http://www.unep-wcmc.org
		UNESCO-MAP Biosphere Reserves	http://ihp-wins.unesco.org/layers
	Natural Habitats	Coral Reefs	https://allencoralatlas.org/
		Seagrass Beds	
		Mangrove Forests	http://www.unep-wcmc.org
Restricted Zone	LPAs and IRAs	LMPAs	
		EBSA	http://www.cbd.int/

lxx Acebes 2014.

lxxi Aragones Laggui, and Amor 2017.

lxxii Acebes et al. 2021.

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TABLE 10: LIST OF THREATENED MARINE SPECIES WITH GLOBAL RANGES OVERLAPPING THE PHILIPPINE EEZ

Class	*Latin Name*	**Common Name**	**IUCN Status**	**Range area (km²)**
Marine Mammals				
MAMMALIA	*Orcaella brevirostris*	Irrawaddy Dolphin	EN	—
MAMMALIA	*Balaenoptera musculus*	Blue Whale	EN	—
MAMMALIA	*Balaenoptera physalus*	Fin Whale	VU	—
MAMMALIA	*Physeter macrocephalus*	Sperm Whale	VU	—
MAMMALIA	*Dugong dugon*	Dugong	VU	—
Birds				
AVES	*Anas luzonica*	Philippine Duck	VU	279,937
AVES	*Aythya ferina*	Common Pochard	VU	27,566,004
AVES	*Anthracoceros marchei*	Palawan Hornbill	VU	41,300
AVES	*Calidris tenuirostris*	Great Knot	EN	3,461,414
AVES	*Calidris pygmaea*	Spoon-billed Sandpiper	CR	355,000
AVES	*Numenius madagascariensis*	Far Eastern Curlew	EN	6,587,512
AVES	*Tringa guttifer*	Spotted Greenshank	CR	749,000
AVES	*Thalasseus bernsteini*	Chinese Crested Tern	CR	114,000
AVES	*Onychoprion aleuticus*	Aleutian Tern	VU	6,660,000
AVES	*Ciconia boyciana*	Oriental Stork	EN	941,000
AVES	*Ceyx melanurus*	North Philippine Dwarf-kingfisher	VU	318,000
AVES	*Egretta eulophotes*	Chinese Egret	VU	860,335
AVES	*Gorsachius goisagi*	Japanese Night-Heron	VU	1,010,000
AVES	*Platalea minor*	Black-faced Spoonbill	EN	169,000
AVES	*Hydrobates matsudairae*	Matsudaira's Storm-Petrel	VU	22,432,343
AVES	*Phoebastria albatrus*	Short-tailed Albatross	VU	48,011,637
AVES	*Pterodroma phaeopygia*	Galapagos Petrel	CR	16,800,000
AVES	*Cacatua haematuropygia*	Philippine Cockatoo	CR	734,000
AVES	*Fregata andrewsi*	Christmas Frigatebird	CR	4,235,730
Marine Turtles				

Class	*Latin Name*	**Common Name**	**IUCN Status**	**Range area (km²)**
REPTILIA	*Chelonia mydas*	Green Turtle	EN	176,482,666
REPTILIA	*Eretmochelys imbricata*	Hawksbill Turtle	CR	276,653,106
REPTILIA	*Lepidochelys olivacea*	Olive Ridley	VU	
REPTILIA	*Caretta caretta*	Loggerhead Turtle	VU	
REPTILIA	*Dermochelys coriacea*	Leatherback Turtle	VU	
Cartilaginous Fish				
CHONDRICHTHYES	*Carcharhinus albimarginatus*	Silvertip Shark	VU	
CHONDRICHTHYES	*Carcharhinus borneensis*	Borneo Shark	EN	2,197,228
CHONDRICHTHYES	*Carcharhinus falciformis*	Silky Shark	VU	
CHONDRICHTHYES	*Lamiopsis temminckii*	Broadfin Shark	EN	3,458,609
CHONDRICHTHYES	*Carcharhinus amblyrhynchos*	Grey Reef Shark	EN	5,939,686
CHONDRICHTHYES	*Carcharhinus obscurus*	Dusky Shark	EN	15,765,442
CHONDRICHTHYES	*Carcharhinus longimanus*	Oceanic Whitetip Shark	CR	200,950,876
CHONDRICHTHYES	*Carcharhinus melanopterus*	Blacktip Reef Shark	VU	
CHONDRICHTHYES	*Hemigaleus elongata*	Snaggletooth Shark	VU	
CHONDRICHTHYES	*Hemigaleus microstoma*	Sicklefin Weasel Shark	VU	
CHONDRICHTHYES	*Halaelurus buergeri*	Blackspotted Catshark	EN	654,029
CHONDRICHTHYES	*Cephaloscyllium fasciatum*	Reticulated Swellshark	CR	40,006
CHONDRICHTHYES	*Eusphyra blochii*	Winghead Shark	EN	9,607,302
CHONDRICHTHYES	*Sphyrna mokarran*	Great Hammerhead	CR	31,445,766
CHONDRICHTHYES	*Sphyrna lewini*	Scalloped Hammerhead	CR	31,603,907
CHONDRICHTHYES	*Sphyrna zygaena*	Smooth Hammerhead	VU	
CHONDRICHTHYES	*Squalus montalbani*	Philippine Spurdog	VU	
CHONDRICHTHYES	*Hemitriakis leucoperiptera*	Whitefin Topeshark	EN	646,297
CHONDRICHTHYES	*Mustelus manazo*	Starspotted Smooth-hound	EN	2,029,405
CHONDRICHTHYES	*Chimaera phantasma*	Silver Chimaera	VU	
CHONDRICHTHYES	*Alopias pelagicus*	Pelagic Thresher	EN	132,386,857
CHONDRICHTHYES	*Alopias superciliosus*	Bigeye Thresher	VU	
CHONDRICHTHYES	*Alopias vulcpinus*	Thresher	VU	
CHONDRICHTHYES	*Cetorhinus maximus*	Basking Shark	EN	221,820,483

Class	*Latin Name*	**Common Name**	**IUCN Status**	**Range area (km^2)**
CHONDRICHTHYES	*Carcharodon carcharias*	White Shark	VU	
CHONDRICHTHYES	*Isurus paucus*	Longfin Mako	EN	185,106,241
CHONDRICHTHYES	*Isurus oxyrinchus*	Shortfin Mako	EN	222,540,198
CHONDRICHTHYES	*Urogymnus granulatus*	Mangrove Whipray	VU	
CHONDRICHTHYES	*Urogymnus lobistoma*	Tubemouth Whipray	EN	395,063
CHONDRICHTHYES	*Pateobatis fai*	Pink Whipray	VU	
CHONDRICHTHYES	*Maculabatis pastinacoides*	Round Whipray	EN	1,371,097
CHONDRICHTHYES	*Himantura uarnak*	Coach Whipray	VU	
CHONDRICHTHYES	*Himantura undulata*	Honeycomb Whipray	EN	1,977,221
CHONDRICHTHYES	*Pateobatis jenskinsii*	Jenkins' Whipray	VU	
CHONDRICHTHYES	*Pateobatis uarnacoides*	Whitenose Whipray	EN	1,987,036
CHONDRICHTHYES	*Maculabatis macrura*	Sharpnose Whipray	EN	2,009,744
CHONDRICHTHYES	*Maculabatis gerrardi*	Whitespotted Whipray	EN	2,116,824
CHONDRICHTHYES	*Taeniurops meyeni*	Blotched Fantail Ray	VU	
CHONDRICHTHYES	*Mobula alfredi*	Reef Manta Ray	VU	
CHONDRICHTHYES	*Mobula kuhlii*	Shortfin Devilray	EN	10,281,673
CHONDRICHTHYES	*Mobula mobular*	Spinetail Devil Ray	EN	200,430,791
CHONDRICHTHYES	*Mobula birostris*	Giant Manta Ray	EN	203,755,004
CHONDRICHTHYES	*Mobula thurstoni*	Bentfin Devilray	EN	213,269,951
CHONDRICHTHYES	*Mobula tarapacana*	Sicklefin Devilray	EN	216,443,327
CHONDRICHTHYES	*Mobula eregoodootenkee*	Longhorned Pygmy Devil Ray	EN	
CHONDRICHTHYES	*Aetomylaeus maculatus*	Mottled Eagle Ray	EN	866,543
CHONDRICHTHYES	*Aetomylaeus vespertilio*	Ornate Eagle Ray	EN	5,655,227
CHONDRICHTHYES	*Rhinoptera javanica*	Javanese Cownose Ray	VU	
CHONDRICHTHYES	*Chiloscyllium hasselti*	Indonesian Bambooshark	EN	274,821
CHONDRICHTHYES	*Rhincodon typus*	Whale Shark	EN	171,328,569
CHONDRICHTHYES	*Stegostoma tigrinum*	Zebra Shark	EN	16,086,945
CHONDRICHTHYES	*Glaucostegus granulatus*	Sharpnose Guitarfish	CR	685,737
CHONDRICHTHYES	*Glaucostegus thouin*	Clubnose Guitarfish	CR	1,293,706
CHONDRICHTHYES	*Glaucostegus typus*	Giant Guitarfish	CR	4,459,625
CHONDRICHTHYES	*Pristis clavata*	Dwarf Sawfish	EN	3,356,258
CHONDRICHTHYES	*Pristis zijsron*	Green Sawfish	CR	5,842,057

Class	*Latin Name*	**Common Name**	**IUCN Status**	**Range area (km^2)**
CHONDRICHTHYES	*Pristis zijsron*	Green Sawfish	CR	5,842,057
CHONDRICHTHYES	*Anoxypristis cuspidata*	Narrow Sawfish	EN	5,923,232
CHONDRICHTHYES	*Pristis pristis*	Largetooth Sawfish	CR	7,356,955
CHONDRICHTHYES	*Pristis pristis*	Largetooth Sawfish	CR	7,356,955
CHONDRICHTHYES	*Rhynchobatus springeri*	Broadnose Wedgefish	CR	2,75,026
CHONDRICHTHYES	*Rhynchobatus australiae*	Bottlenose Wedgefish	CR	4,194,844
CHONDRICHTHYES	*Rhina ancylostoma*	Bowmouth Guitarfish	CR	5,182,345
CHONDRICHTHYES	*Centrophorus isodon*	Blackfin Gulper Shark	EN	35,272
CHONDRICHTHYES	*Centrophorus granulosus*	Gulper Shark	EN	2,898,533
CHONDRICHTHYES	*Centrophorus squamosus*	Leafscale Gulper Shark	EN	3,980,354

TABLE 11: LIST OF DATA SOURCES TO INFORM MARINE SPATIAL PLANNING, SITE SELECTION AND ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

File Name	Layer	Citation	Restrictions	Source
PHL_Critical_ Habitat & PHL_ Critical_Habitat_ indicative				
PHL_WDPA_ Poly_2021	World Database on Protected Areas (WDPA)	IUCN, UNEP-WCMC 2021. The World Database on Protected Areas (WDPA). Cambridge (UK): UNEP World Conservation Monitoring Centre. URL: www. protectedplanet.net	Restricted use, available through Integrated Biodiversity Assessment Tool (IBAT)	www.ibat-alliance.org
PHL_WDPA_ Poly_2021		IUCN, UNEP-WCMC 2021. The World Database on Protected Areas (WDPA). Cambridge (UK): UNEP World Conservation Monitoring Centre. URL: www. protectedplanet.net	Restricted use, available through IBAT	www.ibat-alliance.org
PHL_WDPA_ Poly_2020		IUCN, UNEP-WCMC 2021. The World Database on Protected Areas (WDPA). Cambridge (UK): UNEP World Conservation Monitoring Centre. URL: www. protectedplanet.net	Restricted use, available through IBAT	www.ibat-alliance.org
PHL_KBA_2021	Key Biodiversity Areas	BirdLife International 2021. World Database of Key Biodiversity Areas. Developed by the KBA Partnership: BirdLife International, International Union for the Conservation of Nature, Amphibian Survival Alliance, Conservation International, Critical Ecosystem Partnership Fund, Global Environment Facility, Global Wildlife Conservation, NatureServe, Rainforest Trust, Royal Society for the Protection of Birds, Wildlife Conservation Society and World Wildlife Fund. Available at www. keybiodiversityareas.org.	Restricted use, available through IBAT	www.keybiodiversityareas.org.

File Name	Layer	Citation	Restrictions	Source
PHL_IMMA	Important Marine Mammal Areas (IUCN IMMA)	IUCN MMPATF (2019) Global Dataset of Important Marine Mammal Areas (IUCN IMMA). 2021. Made available under agreement on terms and conditions of use by the IUCN Joint SSC/WCPA Marine Mammal Protected Areas Task Force and accessible via the IMMA e-Atlas http://www.marinemammalhabitat.org/imma-eatlas/	Restricted use , For commercial use, please contact: immacoordinator@gmail.com	http://www.marinemammalhabitat.org/imma-eatlas/
PHL_MAB				http://ihp-wins.unesco.org/layers
PHL_WDPA_Poly_2021				
PHL_Seagrass	Seagrass	Allen Coral Atlas maps, bathymetry and map statistics are © 2018-2021 Allen Coral Atlas Partnership and Vulcan, Inc. and licensed CC BY 4.0 (https://creativecommons.org/licenses/by/4.0/)	No restrictions	https://allencoralatlas.org/
PHL_Coral	Coral	Allen Coral Atlas maps, bathymetry and map statistics are © 2018-2021 Allen Coral Atlas Partnership and Vulcan, Inc. and licensed CC BY 4.0 (https://creativecommons.org/licenses/by/4.0/)	No restrictions	https://allencoralatlas.org/
PHL_GMW_2016_v2	Mangroves	Global Mangroves Watch 2016	No restrictions	https://clarklabs.org/
PHL_EBSA		Convention on Biological Diversity (CBD) 2021	No restrictions	https://www.cbd.int/

TABLE 12: ENVIRONMENTAL STAKEHOLDERS

Early and constructive stakeholder engagement is an essential component of identifying priority biodiversity values, verifying data, and ensuring they are considered appropriately and proportionately in planning for offshore wind development. Stakeholder engagement should be an integral and important part of future MSP and ESIA processes. A list of relevant environmental stakeholders has been identified and is provided in the following table.

Stakeholder	Type	Website
National Stakeholders		
Biodiversity Management Bureau (DENR-BMB)	Government Agency	https://bmb.gov.ph/index.php
Coral Reef Visualization and Assessment (CoRVA) Program	Government Program	http://202.90.159.82/corva/
Department of Environment and Natural Resources (DENR)	Government Agency	https://www.denr.gov.ph/
Department of Agriculture Bureau of Fisheries and Aquatic Resources (BFAR)	Government Agency	https://www.bfar.da.gov.ph/
Department of Environment and Natural Resources (DENR)	Government Agency	https://www.denr.gov.ph/
Ecosystem Research and Development Bureau (DENR-ERDR)	Government Agency	http://erdb.denr.gov.ph/
Environmental Management Bureau (DENR-EMB)	Government Agency	https://emb.gov.ph/
Mangrove & Beach Forest Development Project (MBFDP)	Government Project	http://erdb.denr.gov.ph/2015/11/27/mangrove-beach-forest-development-project/
National Mapping and Resource Information Authority (NAMRIA)	Government Agency	https://www.namria.gov.ph/
Natural Resources Development Corporation (NRDC)	Government Agency	https://nrdc.denr.gov.ph
Palawan Council for Sustainable Development (PCSD)	Government Agency	https://pcsd.gov.ph/
Biodiversity Conservation Society of the Philippines	NGO	http://www.biodiversity.ph/
Coral Cay Conservation	NGO	https://www.coralcay.org/
Foundation for the Philippine Environment	NGO	https://fpe.ph/
Haribon Foundation (BirdLife Partner)	NGO	www.haribon.org.ph
Large Marine Vertebrates Research Institute Philippines (LAMAVE)	NGO	https://www.lamave.org
Marine Conservation Philippines	NGO	https://www.marineconservationphilippines.org/
Marine Wildlife Watch of the Philippines	NGO	http://mwwphilippines.org/pawikanwatchph/
People and the Sea	NGO	https://www.peopleandthesea.org/
Philippine Mangroves: Biodiversity, Conservation and Management	NGO	https://mangroveecology.com/
Quantitative Aquatics, Inc. (Q-quatics)	NGO	https://www.q-quatics.org/
Save Philippine Seas	NGO	https://www.savephilippineseas.org/
Sea Institute	NGO	http://seainstitute.org/
Society for Conservation of Philippine Wetlands	NGO	https://www.wetlands.ph/
The Philippine Marine Mammal Stranding Network (PMMSN)	NGO	http://pmmsn.org/

Stakeholder	Type	Website
De La Salle University Br. Alfred Shields FSC Ocean Research (SHORE) Center	Academic Institute	https://www.dlsu.edu.ph/research/research-centers/shore/
The University of Philippines Marine Mammal Research & Stranding Laboratory	Academic Institute	https://iesm.science.upd.edu.ph/
The University of Philippines Marine Science Institute (MSI)	Academic Institute	http://www.msi.upd.edu.ph/
International Stakeholders		
Conservation International Philippines	NGO	https://www.conservation.org/philippines
Global Mangrove Alliance	NGO	https://www.mangrovealliance.org/
Oceana Philippines	NGO	https://ph.oceana.org/
Rare	NGO	https://rare.org/
Sea Around Us Fisheries, Ecosystems & Biodiversity	NGO	http://www.seaaroundus.org/
Seagrass Watch Philippines	NGO	https://www.seagrasswatch.org/philippines/
Sustainable Fisheries Partnership	NGO	https://www.sustainablefish.org/
WWF Philippines	NGO	https://wwf.org.ph/
Coral Triangle Initiative on Coral Reefs, Fisheries, and Food Security (CTI-CFF)	Multilateral Partnership	https://www.denr.gov.ph
Dugong and Seagrass Hub	Multilateral Partnership	https://www.dugongseagrass.org/
EAAFP	Multilateral Partnership	https://www.eaaflyway.net/
UNDP Biodiversity Finance Initiative (BIOFIN)	Multilateral Initiative	https://www.biofin.org/philippines
GIZ Philippines	Government Agency (Germany)	https://www.giz.de/en/worldwide/376.html
UNDP Philippines	IGO	https://www.ph.undp.org/
UNDP Global Marine Commodities (GMC) (2017–2021)	Research Project	https://globalmarinecommodities.org/en/home/
UNDP Philippines SMARTSeas PH	Research Project	https://oceanconference.un.org/commitments/?id=17454

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