

# OFFSHORE WIND



## Offshore Windfarm Analysis Challenges and Opportunities



# Agenda

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1

Growth in the Offshore Windfarm Sector

2

Loss Overview

3

Loss Analysis

4

Catastrophe Modelling

# OFFSHORE WIND

## Section 1

# Growth in the Global Offshore Windfarm Sector

# Offshore Windfarm Opportunities and Challenges

## Opportunities

many of the same advantages as land-based windfarms  
Faster and steadier wind supply  
Higher Energy demand in Coastal Areas  
Less demand for land



## Challenges

Expensive and difficult to build and maintain  
Technical threshold  
Fishery environment and marine ecology  
Safety at Sea – Difficult to manage the area

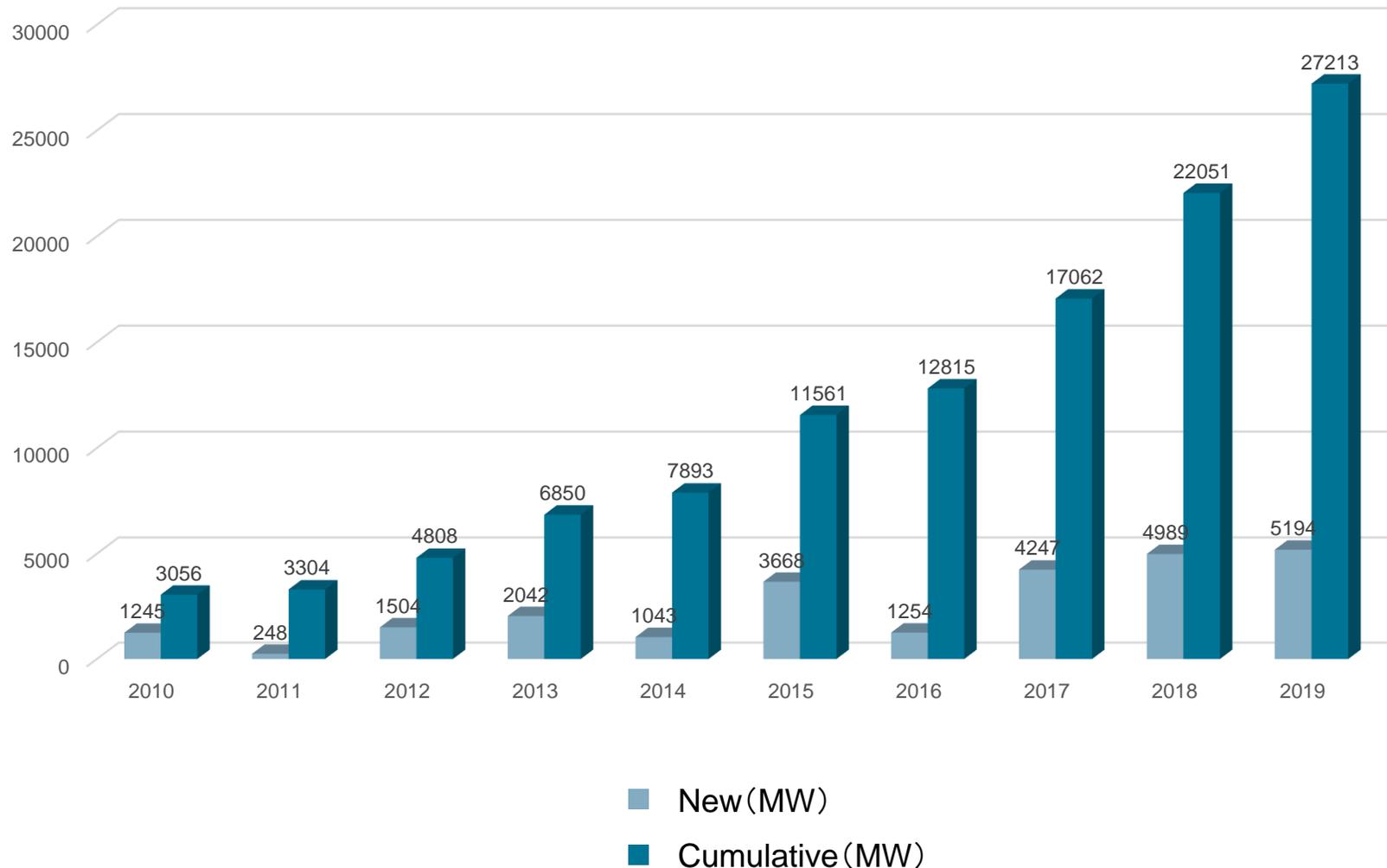


Lack of suitable offshore wind CAT model (vulnerability curves)  
Lack of sector experience  
Lack of local market insurance appetite

Source: <https://www.americangeosciences.org/>

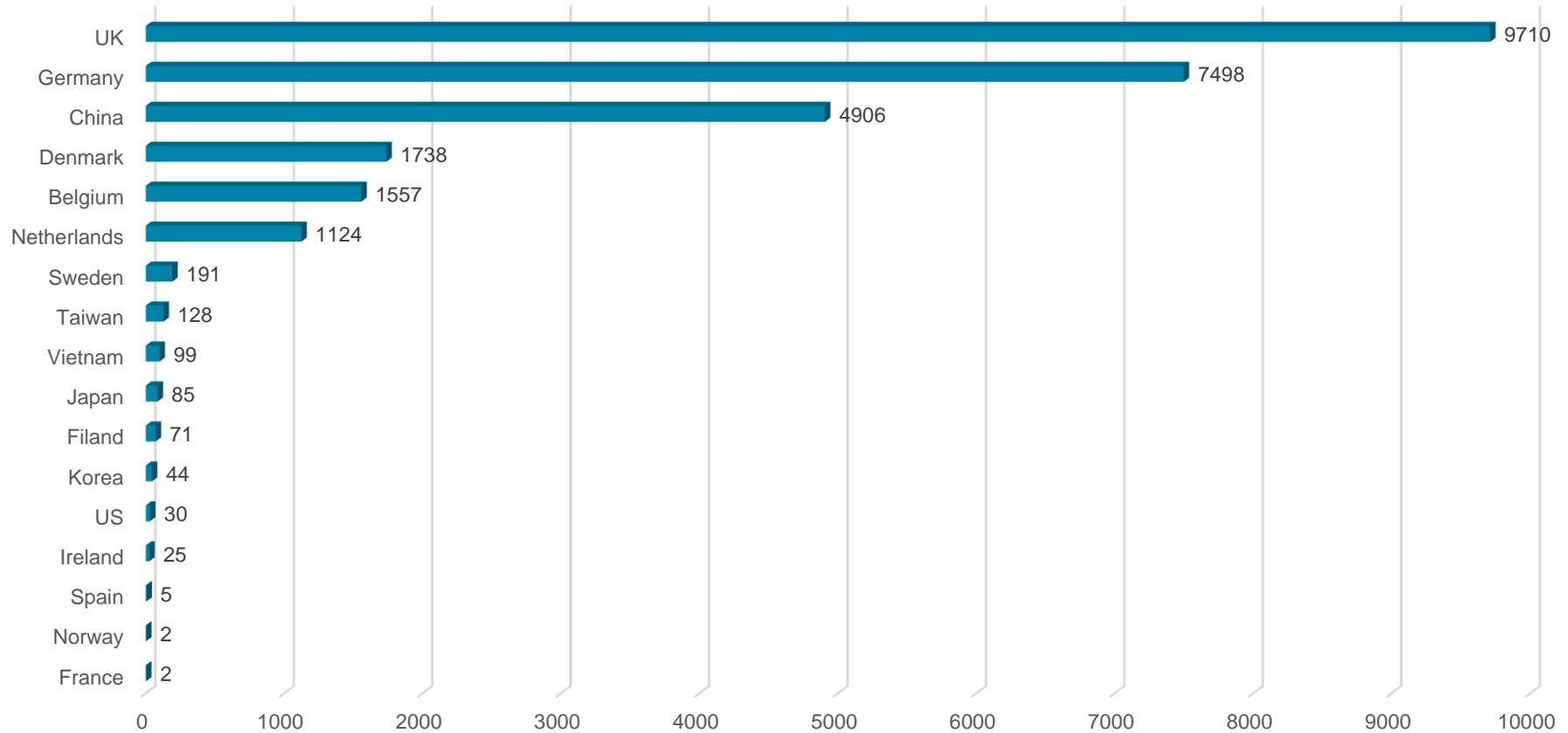
# Global Market Overview

2010-2019 Global Offshore Wind Turbine New and Cumulative Volume(MW)

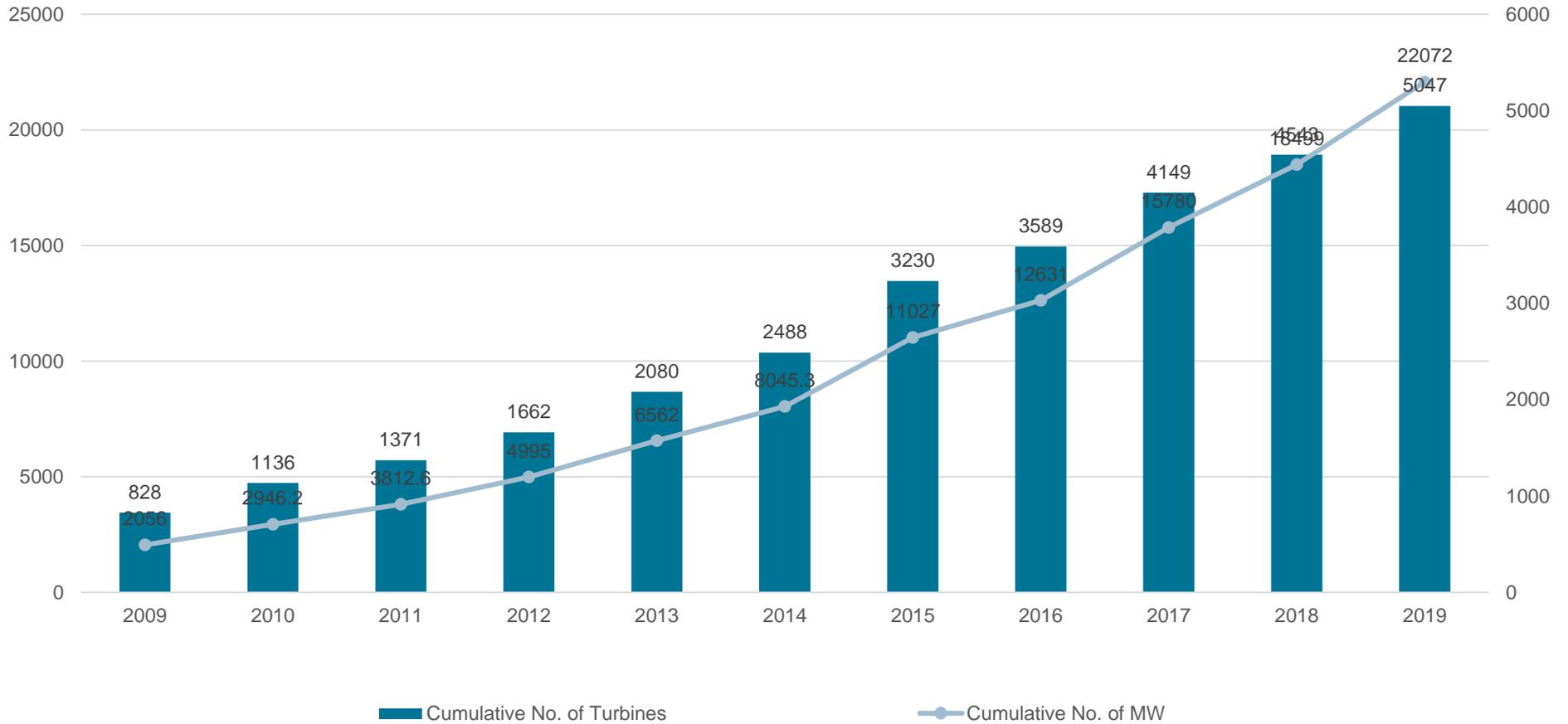


# Global Market Overview

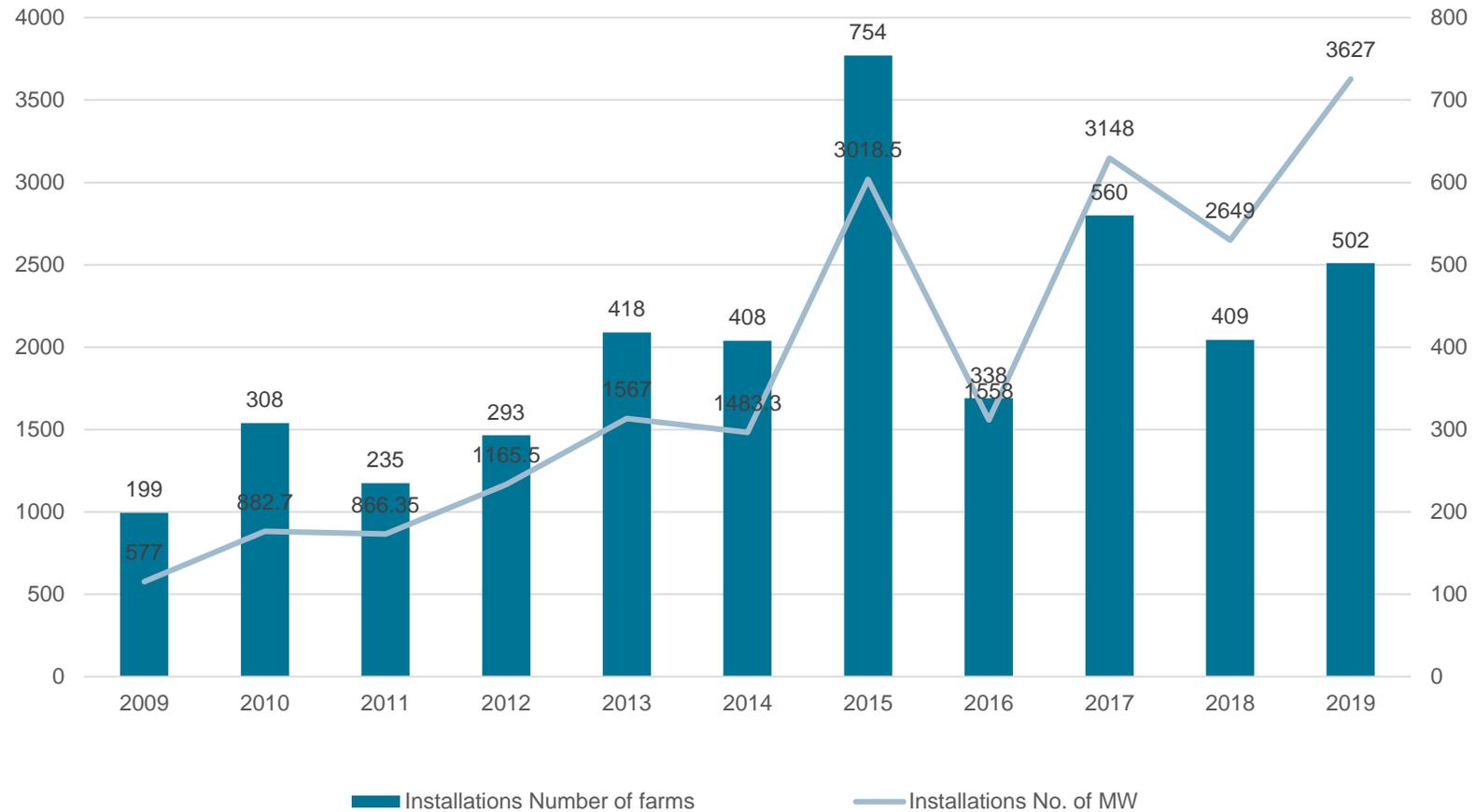
2019 Global Offshore Wind Turbine Volume Distribution (MW)



# Growth in the European Market



# Growth in the European Market

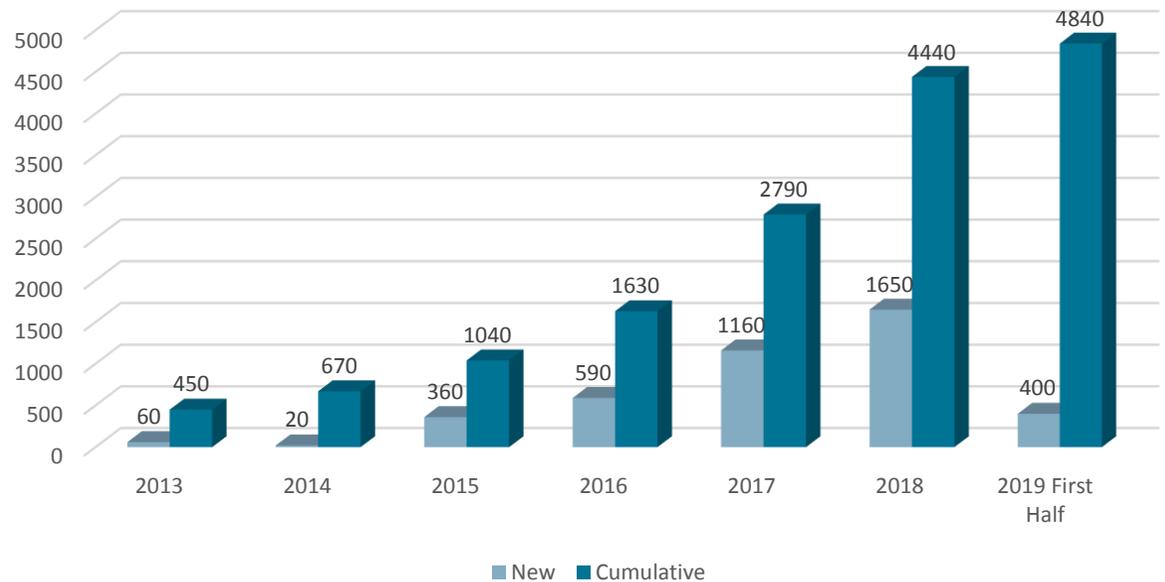


# Mainland China

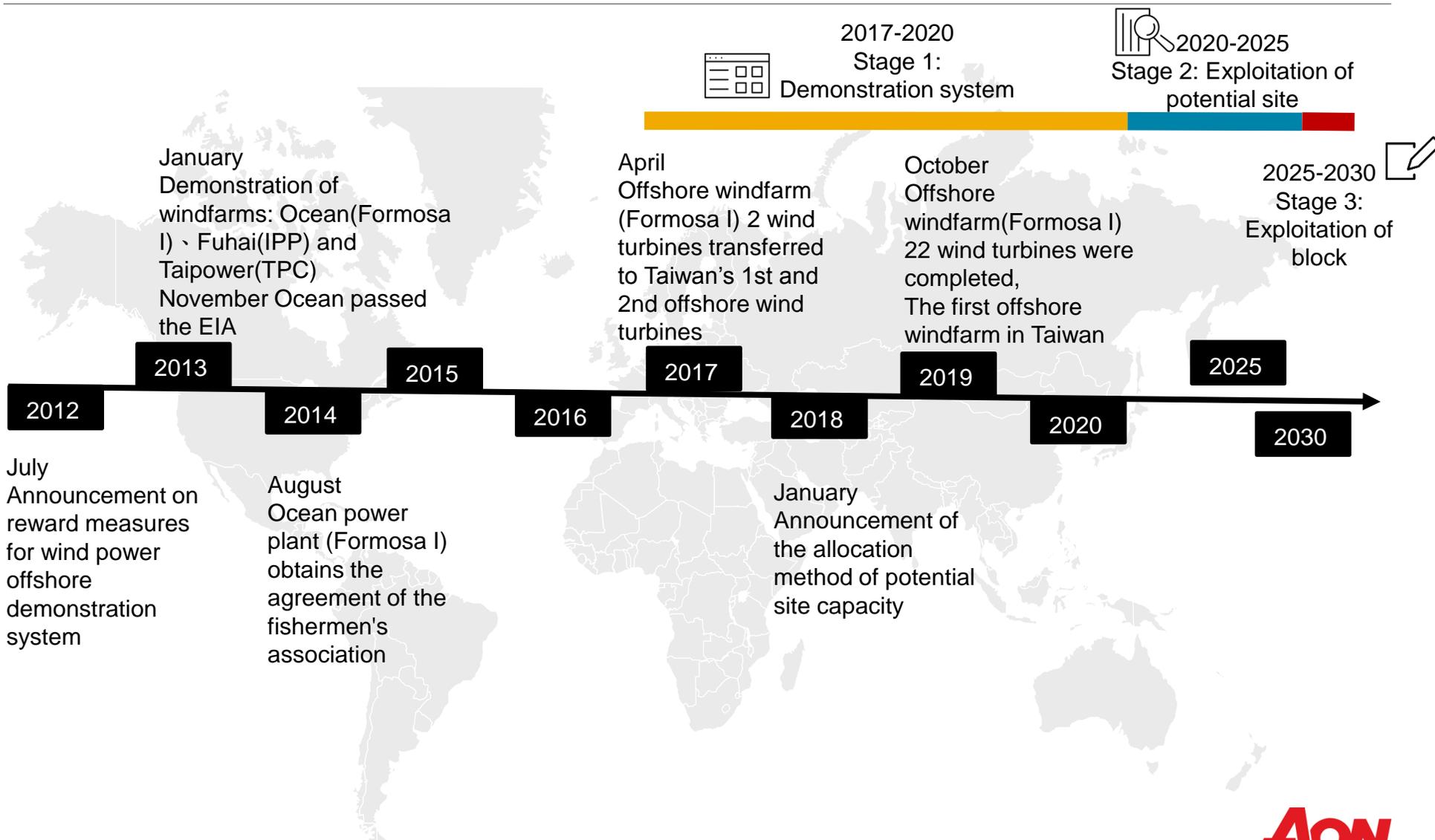
## 13th and 14th Five-Year Plan of Eight Provinces

	Size (MW)	Number of Projects
Guangdong	6685	19
Jiangsu	1500	13
Fujian	1330	10
Zhejiang	400	6
Shandong	1400	6
Hebei	560	1
Liaoning	220	2
Guangxi	510	0

2013 - 2019 First Half China offshore windfarms  
new and cumulative installed capacity  
(MW)

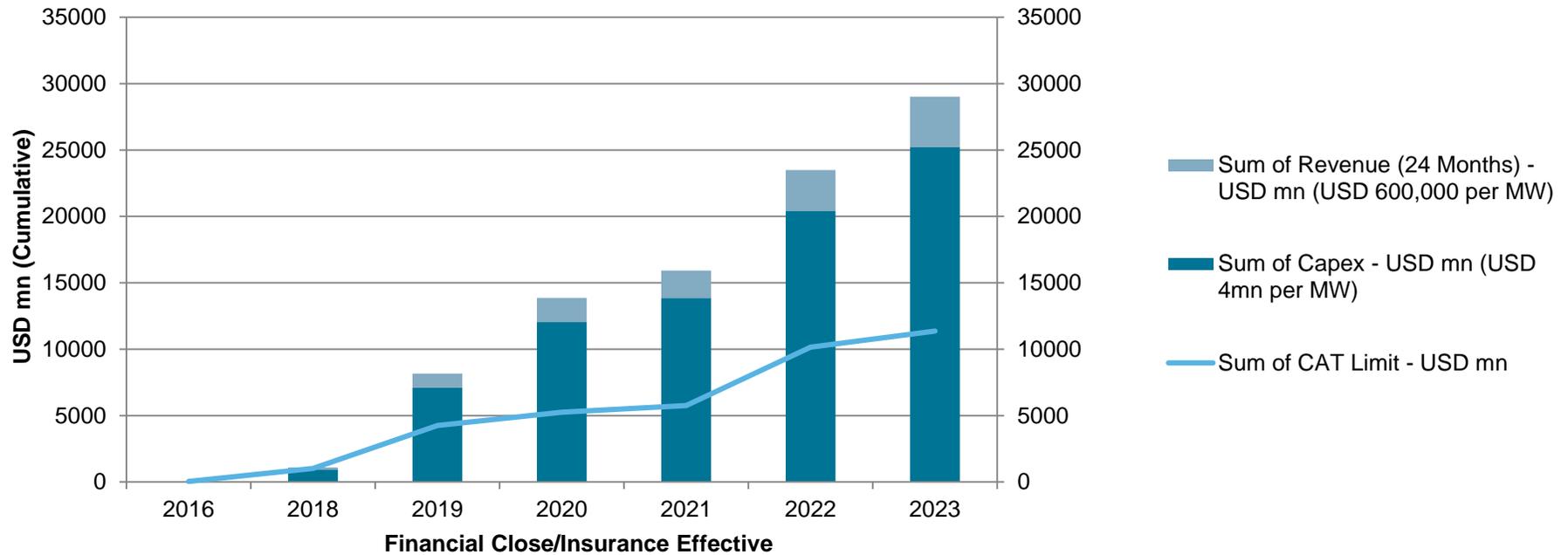


# Windfarm Roadmap in Taiwan



# Projects with Targeted Grid Connections

## Estimations of Capex and required CAT limits





# Key Stakeholders of a Typical Offshore Windfarm Project

## Project main participant

### Owners and Investors

The investor of a construction project or an independent legal entity specially established by the investor for the construction project

Personnel loss



Material loss



Third party liability loss

### Equipment Supplier

Equipment suppliers related to project engineering, such as offshore wind turbines, submarine cables, and electrical equipment of offshore booster stations.

Wind turbine loss



Submarine cable loss



Electrical equipment loss

### Construction Contractor

General contractor or subcontractor of the project, such as wind turbine installation, submarine cable laying, shore engineering, and engineering transportation

Personnel loss



Liability loss



Material loss

### Other Service Entities

Including prophase design and survey entities, as well as consulting companies such as engineering supervision, insurance, and maritime surveyors

Personnel loss



Professional liability loss



Material loss

Each project subject faces the challenge of its own risk of loss

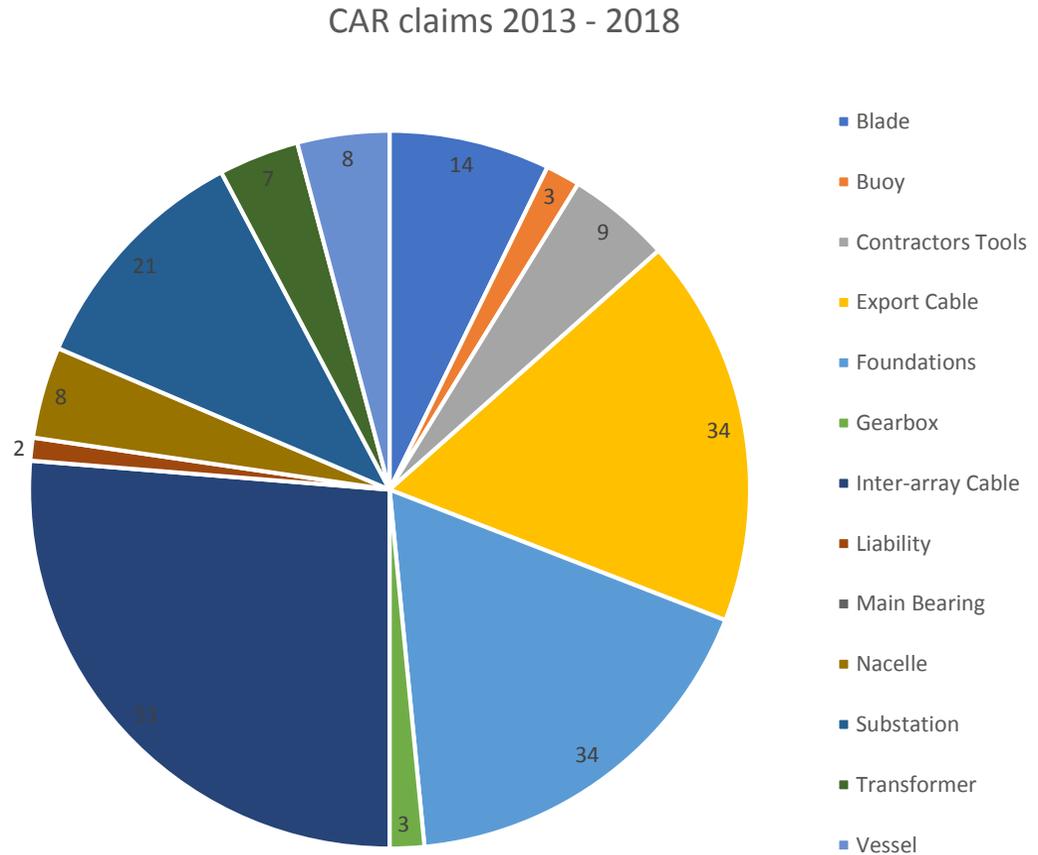
# Loss Statistics

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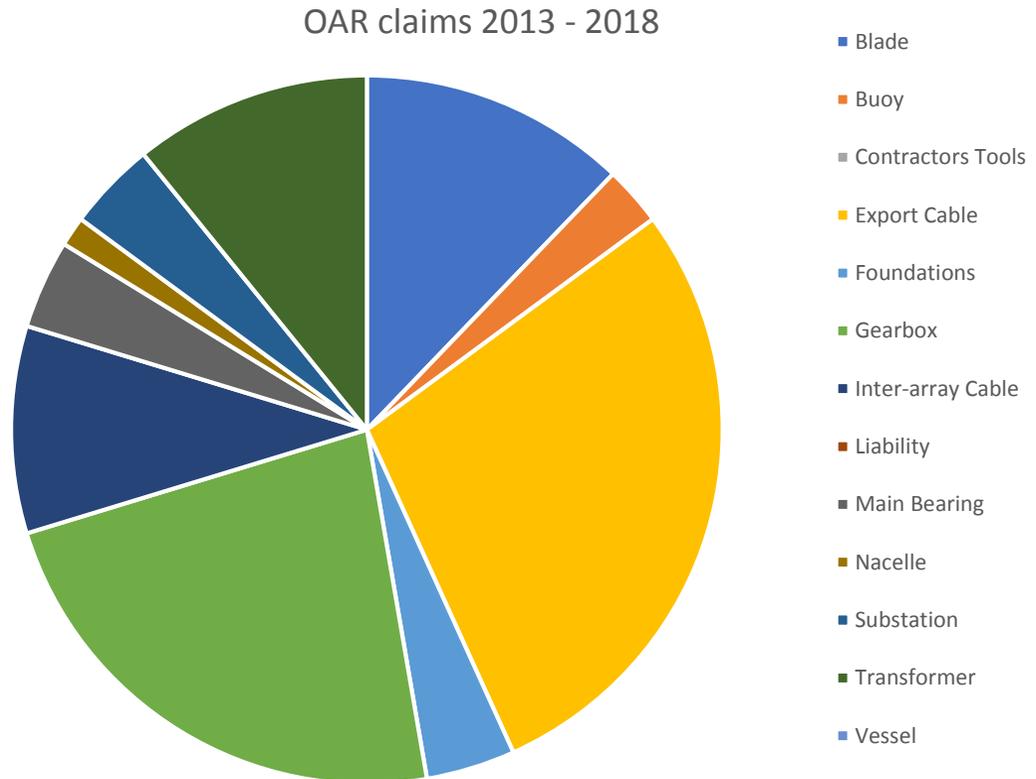
# CAR Claims by Category

	CAR
Blade	14
Buoy	3
Contractors Tools	9
Export Cable	34
Foundations	34
Gearbox	3
Inter-array Cable	51
Liability	2
Nacelle	8
Substation	21
Transformer	7
Vessel	8
Total	194



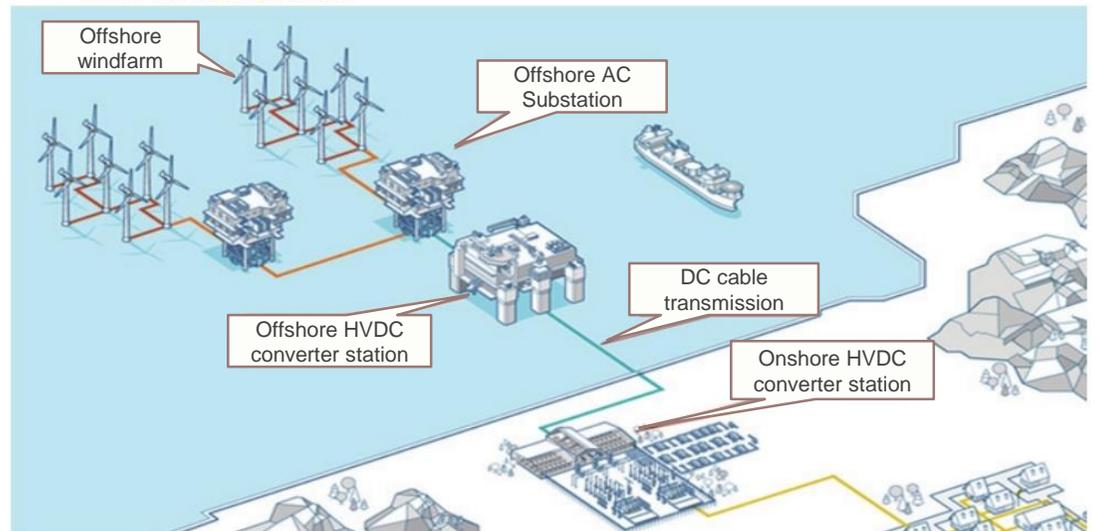
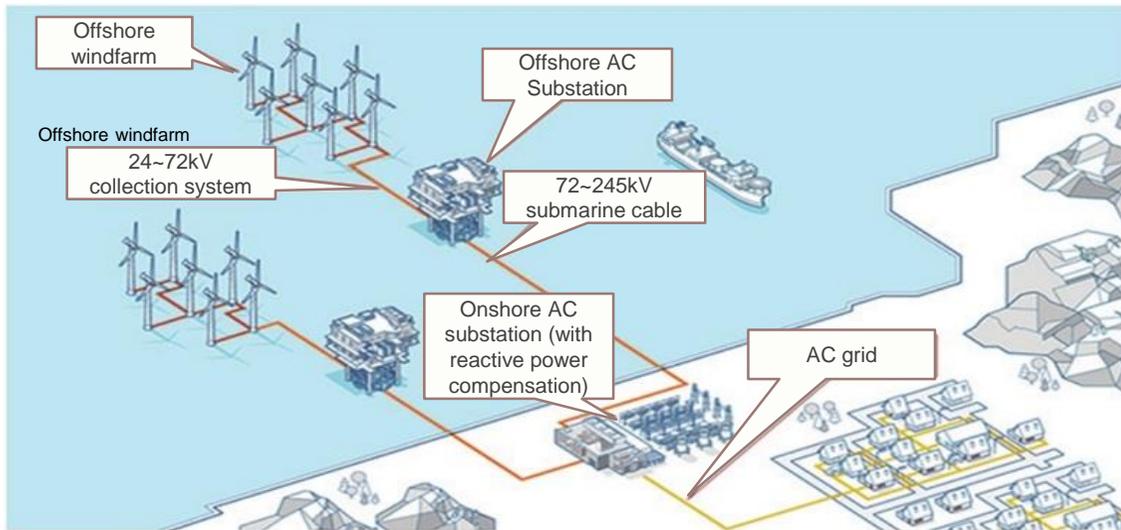
# OAR Claims by Category

	OAR
Blade	9
Buoy	2
Export Cable	21
Foundations	3
Gearbox	17
Inter-array Cable	7
Main Bearing	3
Nacelle	1
Substation	3
Transformer	8
Total	74

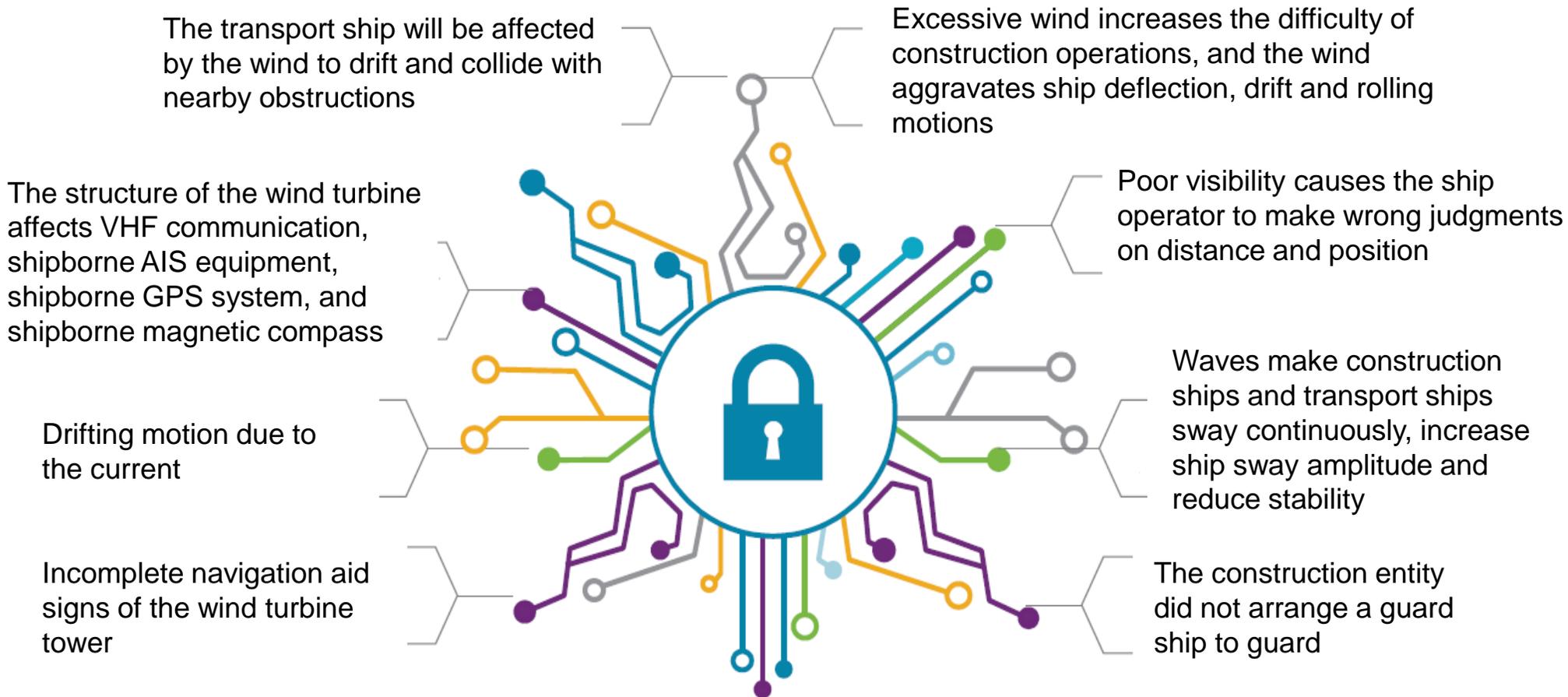




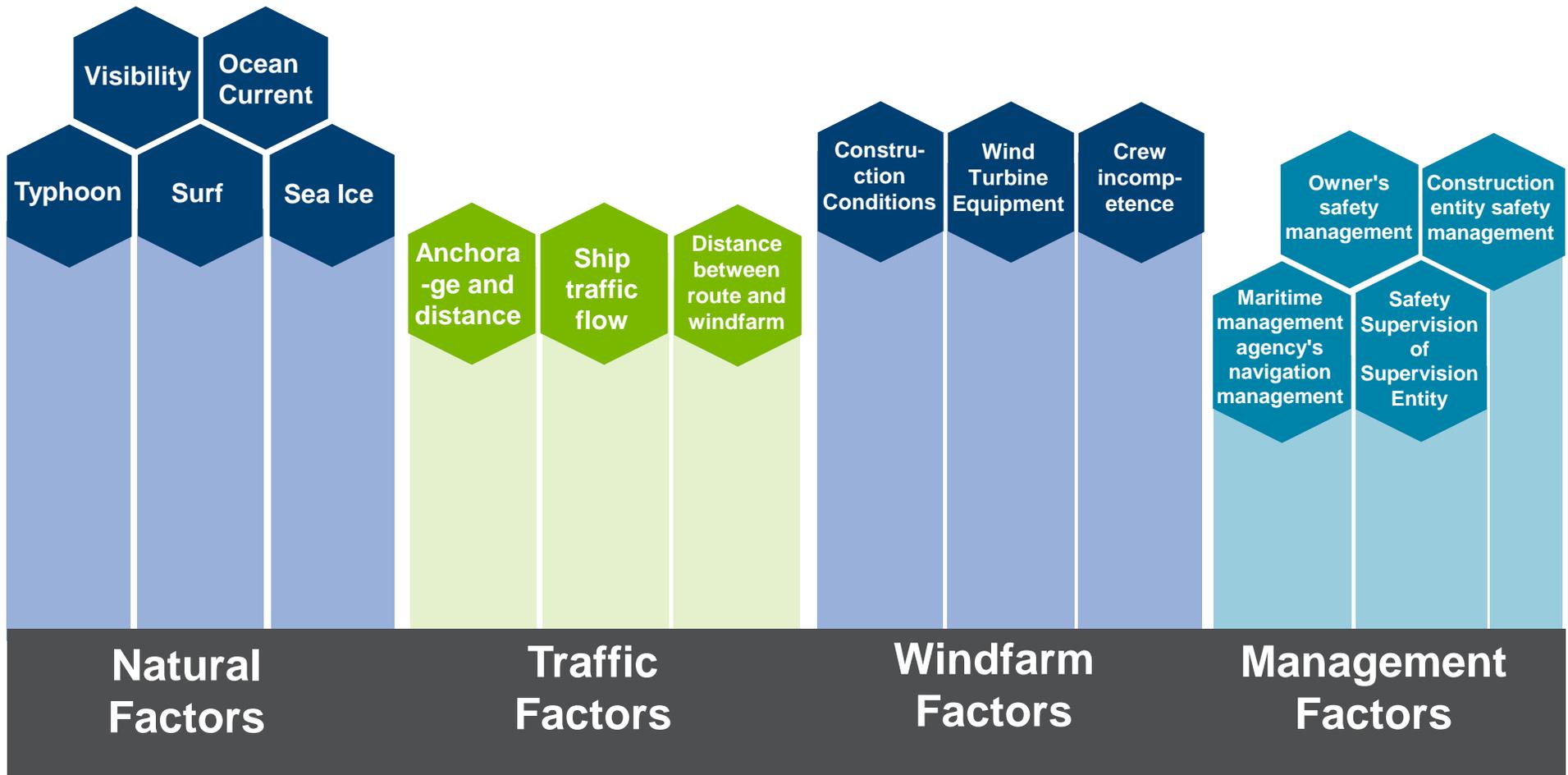
# Typical Layout of Offshore Windfarm Sites



# Cause of Loss - Collision



# Risk components for Collision



# Direct Loss Composition

According to relevant laws and regulations, the damaged wind turbine foundation for scrap treatment should be completely demolished (including pile foundation); if the pile foundation cannot be completely demolished, it should be cut below the seabed bottom

“The direct cost of demolition is nearly 50,000,000 RMB”



# Indirect Loss – BI Components

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**Production  
schedule of basic  
manufacturer is  
almost saturated,  
and the delivery  
time is lagging**

**Engineering  
ship needs to  
wait for the  
appropriate  
weather**

**Engineering  
ship repair at  
the port**

# OFFSHORE WIND

## Section 4

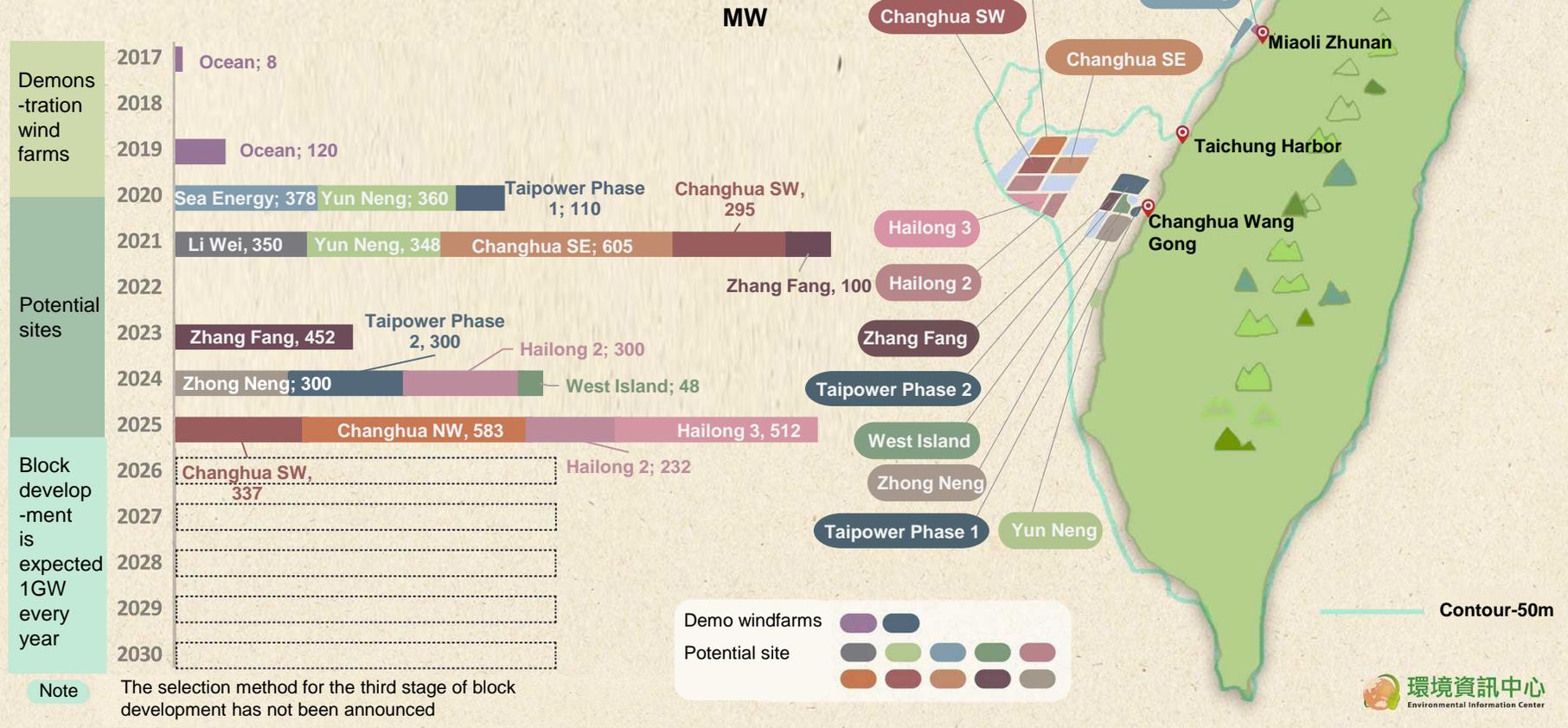
# Catastrophe Modelling



# Offshore Wind farm in Taiwan

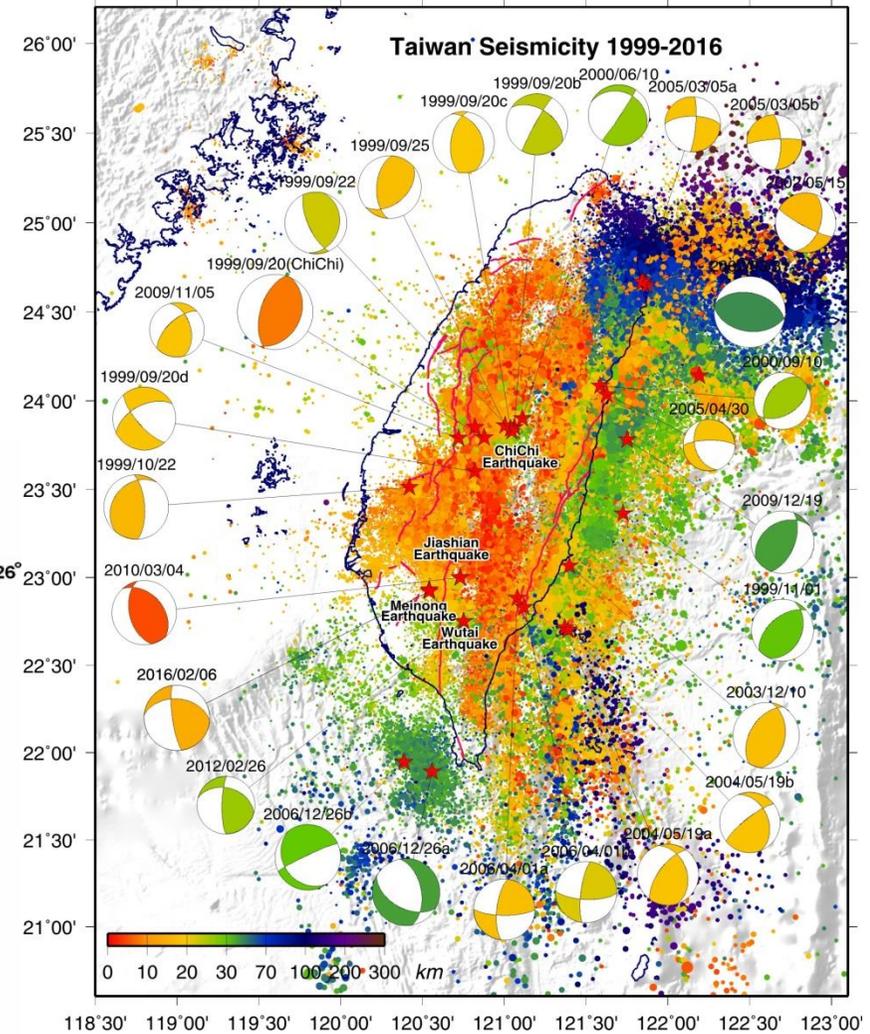
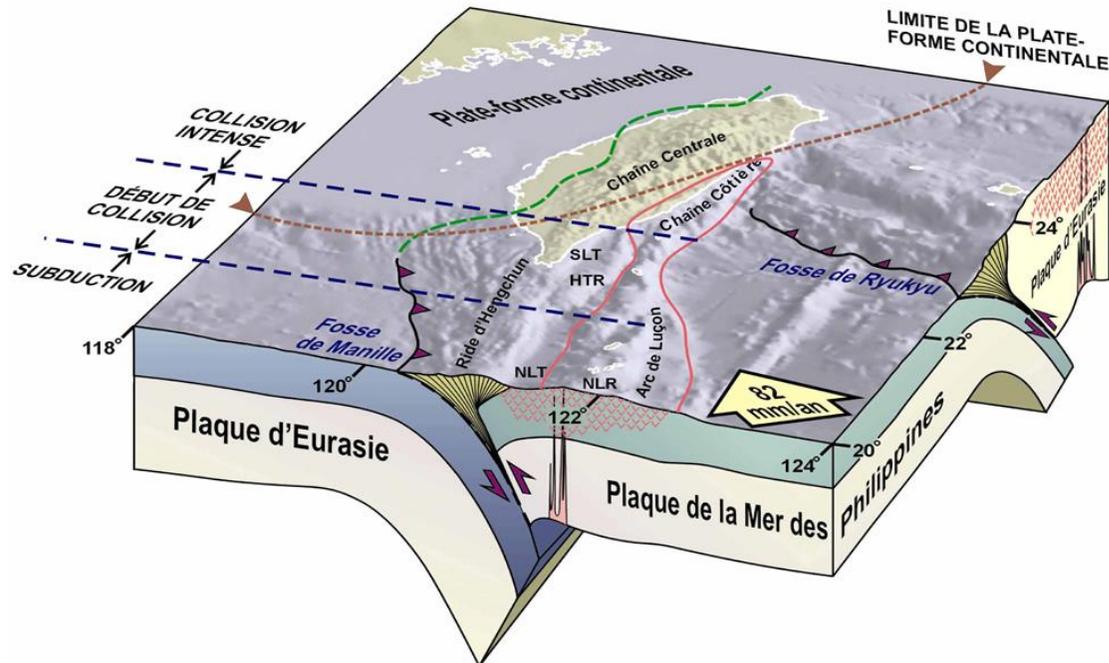
## Where to build offshore windfarm? When?

Wind farms obtained grid-connected qualifications before 2025 and their capacity

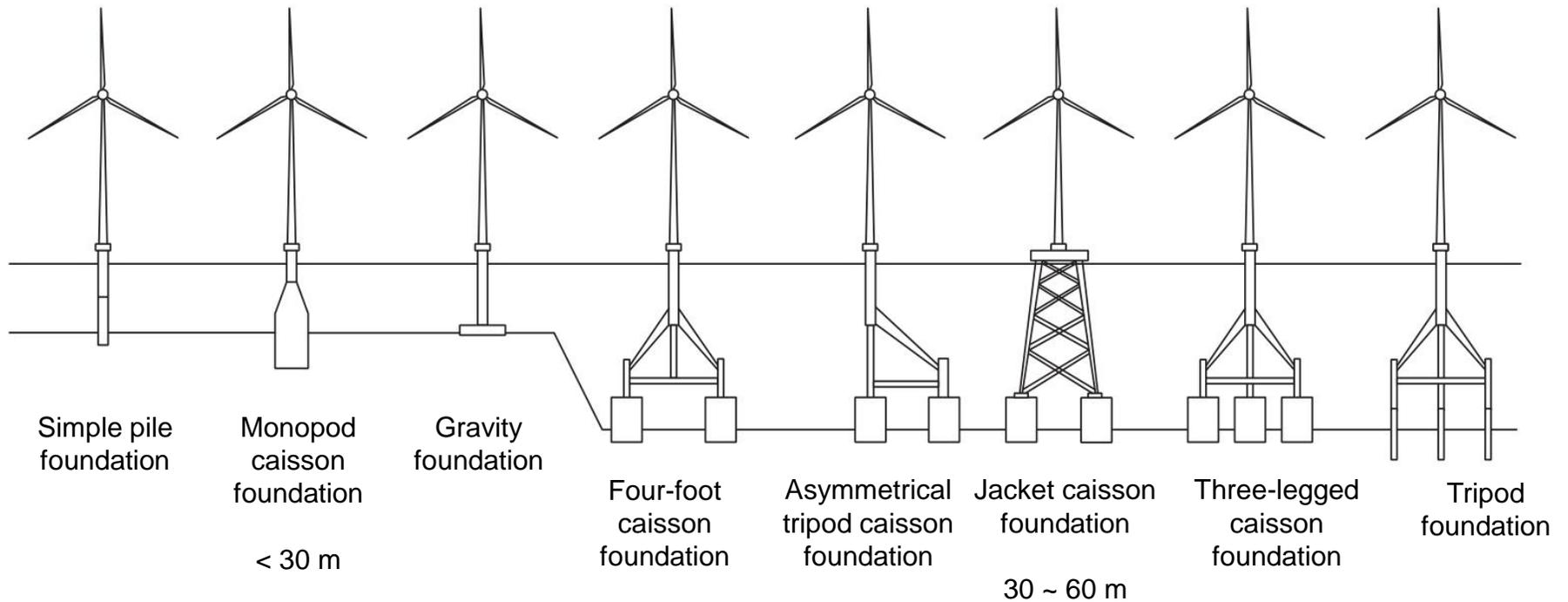


# Earthquake

- Vulnerability curve of each building body
  - Wind turbine – supporting structure
  - Substation
  - High-voltage converter station
  - Submarine cable
  - Business interruption



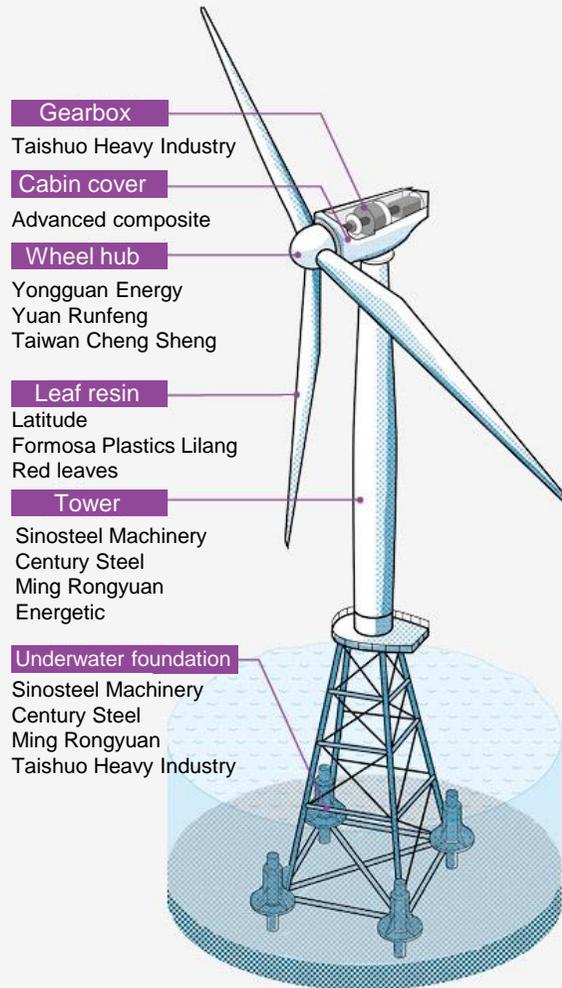
# Structural Foundation Types





# Information Required

## Taiwan offshore wind turbine supply chain



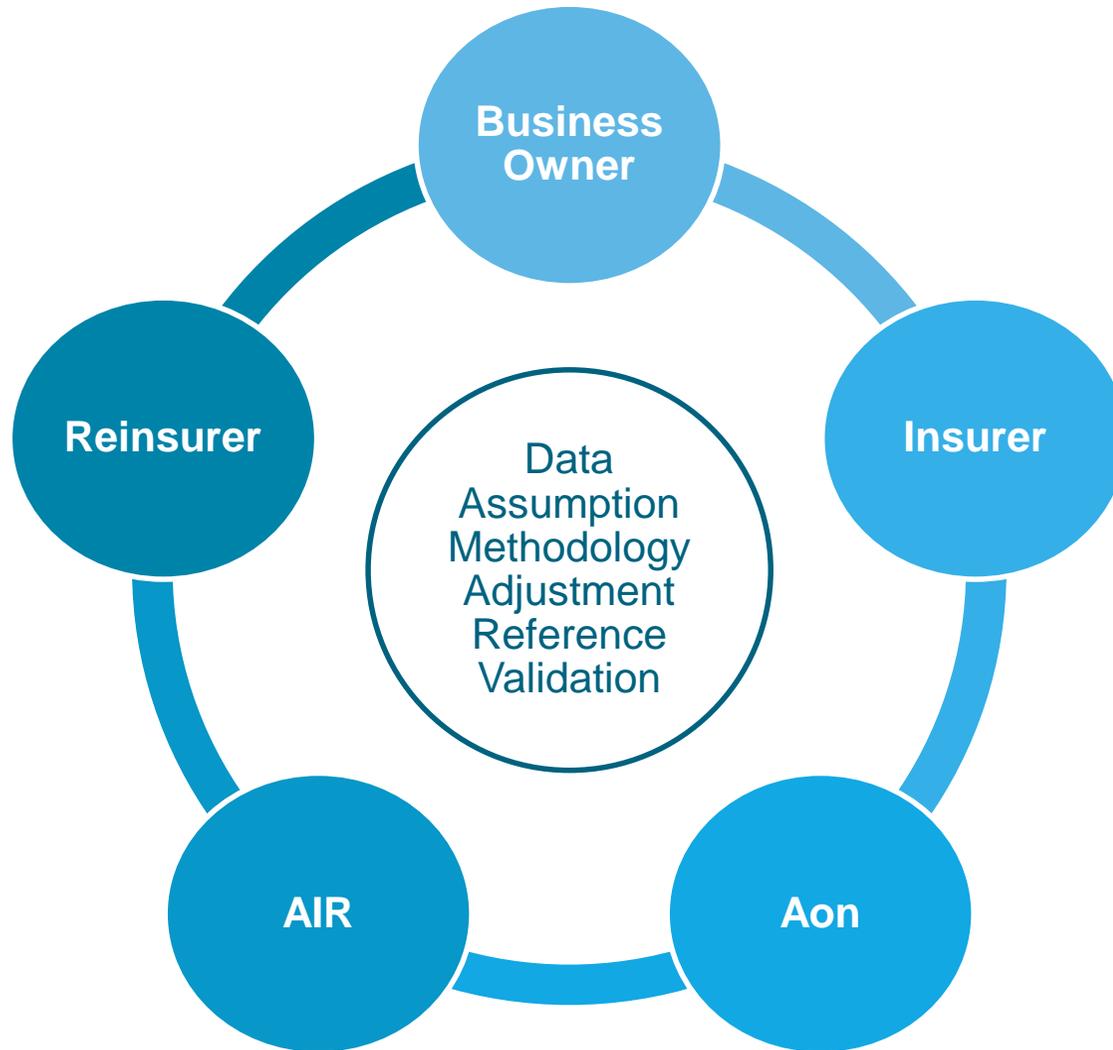
資料來源：經濟部工業局

Waters	Depth/m	Technology Application
Shallow water	0~30	Use fixed single pile foundation and gravity foundation and proven technology based on onshore system
Transition depth zone	30~60	Use fixed jacket foundation or pile group foundation to provide a stronger base for the wind turbine; similar to shallow water, more ships are required for deeper deployment
Deep water	>60	The floating structure separated from the base has better flexibility in site selection; expands the scale of construction; reduces offshore operations. Typical structures include semi-submersible platform, Spar platform and tension leg platform

### • Model Input

- Geographical location / Water depth
- Sum insured / Number of wind turbines
- Building type / height / building age
- Design information
- Policy situation
- Geological / Regional information

# An on-going joint effort of all participants



- Model purpose
- Limitations of Information/data
- Design parameters
- Model approach
- Adjustment factor
  - Engineering Insurance
  - Seasonal disaster
  - Rescue cost
- Result verification

# The Aon **DIFFERENCE**



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