

A photograph of an offshore wind farm with several wind turbines in a row, extending into the distance over a calm sea under a clear blue sky. The turbines are reflected in the water.

An introduction to offshore windfarms risks: 離岸風場風險簡介： Lessons learned from Europe 歐洲經驗與教訓

May 2016
2016年5月30日

Aon Risk Solutions
Aon風險解決方案

Risk. Reinsurance. Human Resources.
風險、再保險、人力資源

AON
Empower Results®

Introduction to Tim Halperin-Smith 講者簡介

- Director and Renewable Energy Team Leader in the Aon Power Division, London
- 倫敦Aon Power事業處處長兼再生能源團隊領導。
- Renewable Energy Insurance broker for 8 years
- 擔任再生能源保險經紀人8年。
- Working in the offshore wind sector for 6 years
- 服務離岸風電產業6年。
- Offshore Wind Placement experience exceeding 5 GW across Europe, US and the Asia including Taiwan's first offshore wind pilot project
- 在歐洲、美國和亞洲，離岸風電安置經驗超過5GW，包括台灣第一個離岸風電先導計畫。



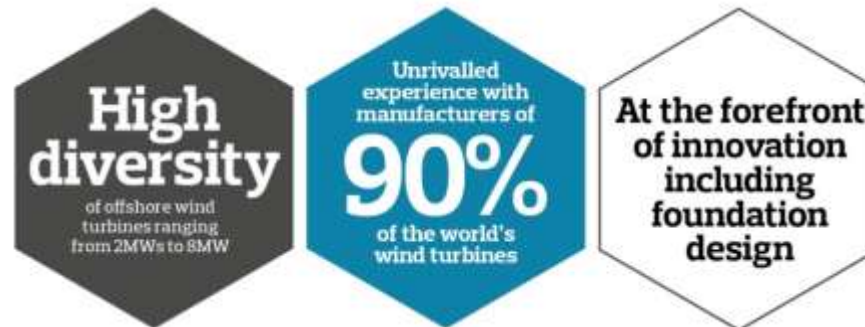
Introduction to Aon: Market Leading Offshore Wind Capabilities

Aon公司簡介：領導市場的離岸風電能力



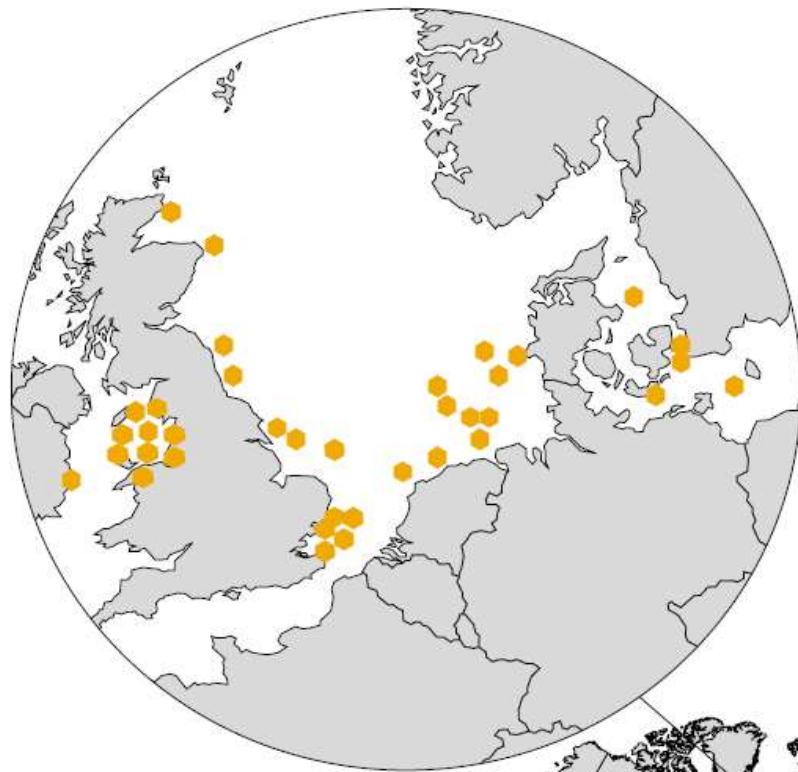
Proven expertise in developing risk solutions for diverse and innovative technologies:

經過驗證為多樣及創新技術發展風險解決方案的專門知識：



European Offshore Wind Experience

歐洲離岸風電經驗

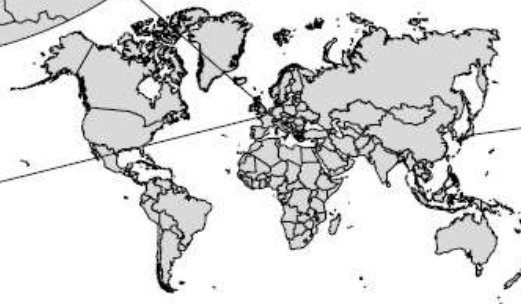


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Insurance broker for
offshore wind

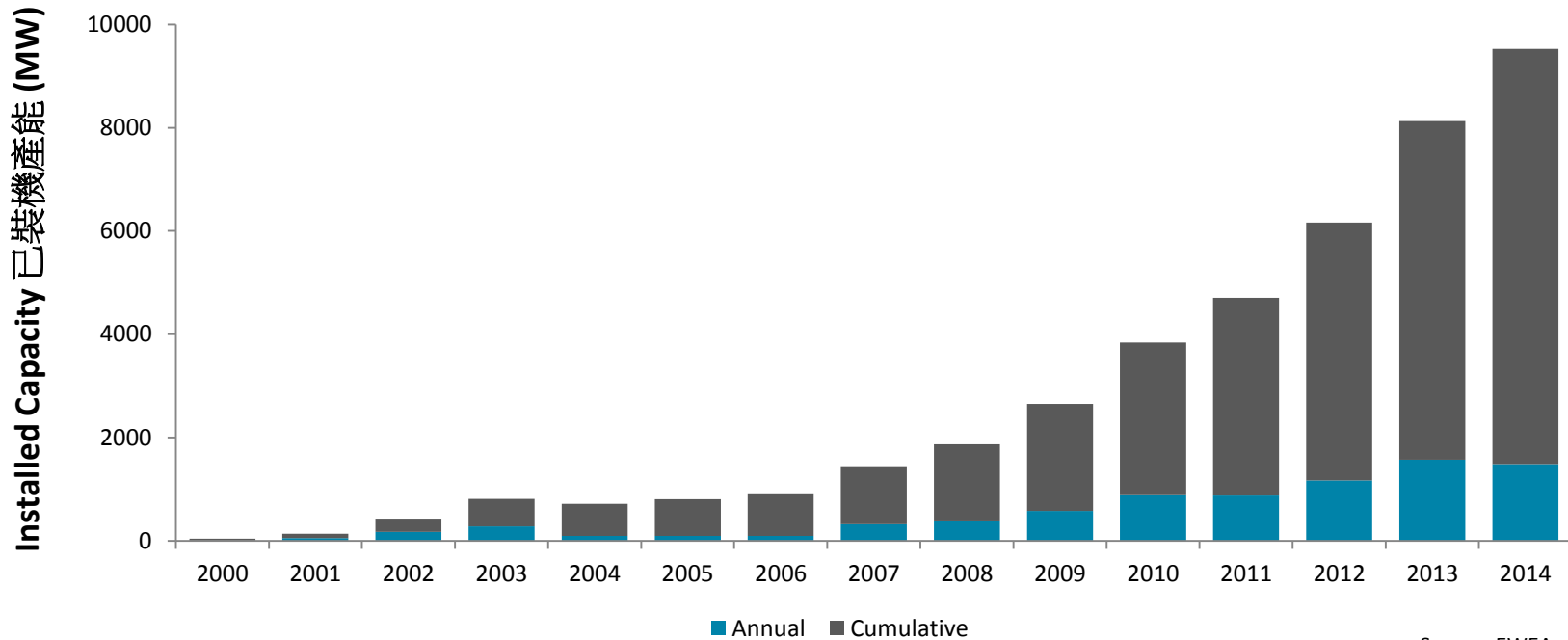
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離岸風場保險經紀商



The development of the offshore wind sector in Europe

歐洲離岸風電產業之發展

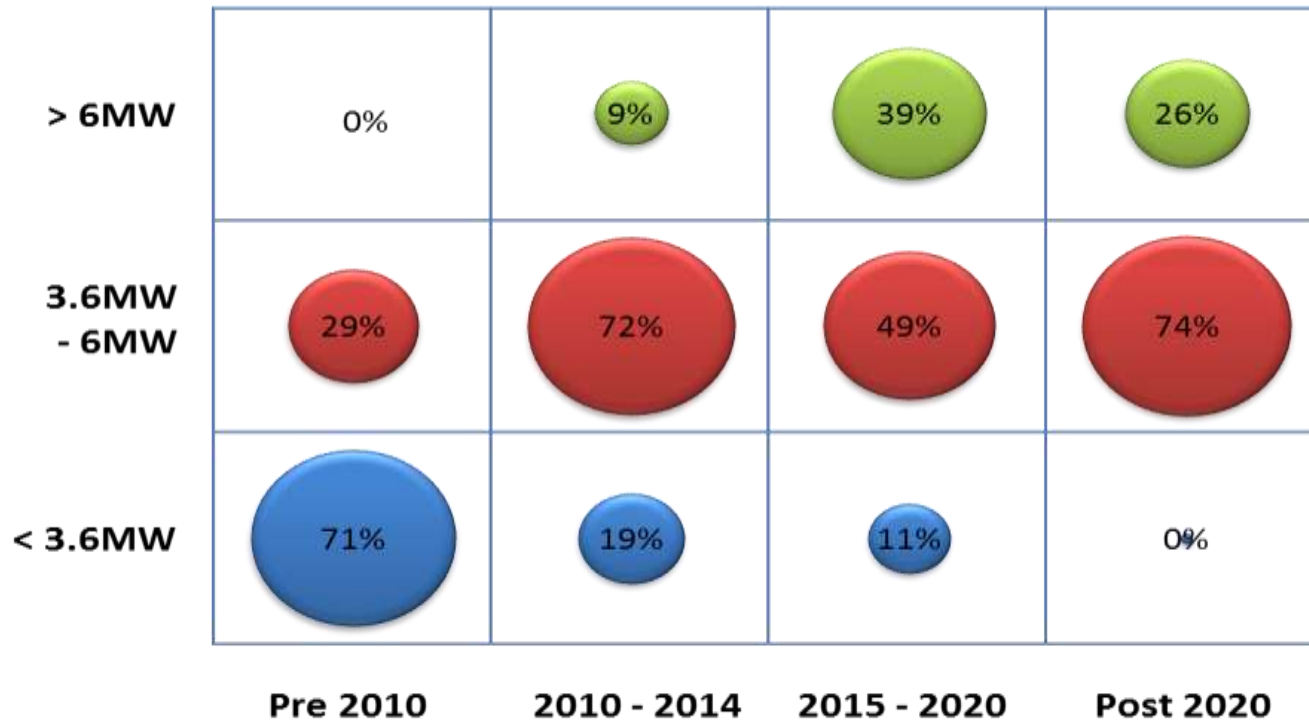


Source: EWEA

Government support + Supply chain development + Technology advances + Available financing = Exponential growth
政府支援 + 供應鏈發展 + 技術進步 + 可用融資 = 指數成長

The size and scale of offshore wind turbines increases

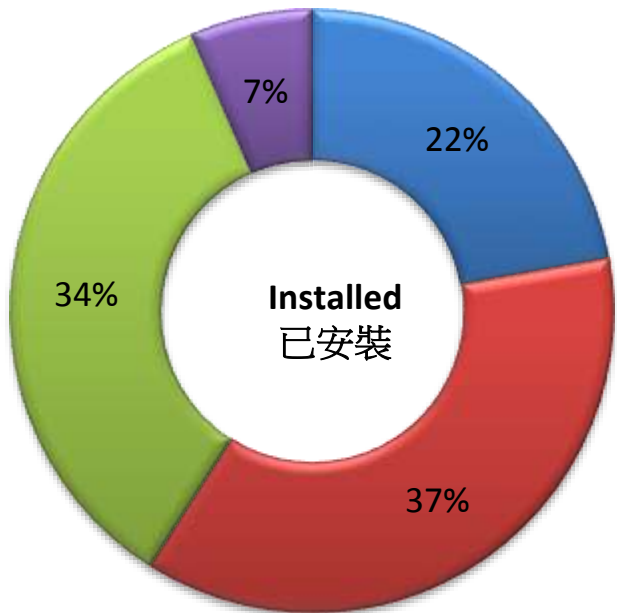
離岸風電渦輪機增加數量和規模



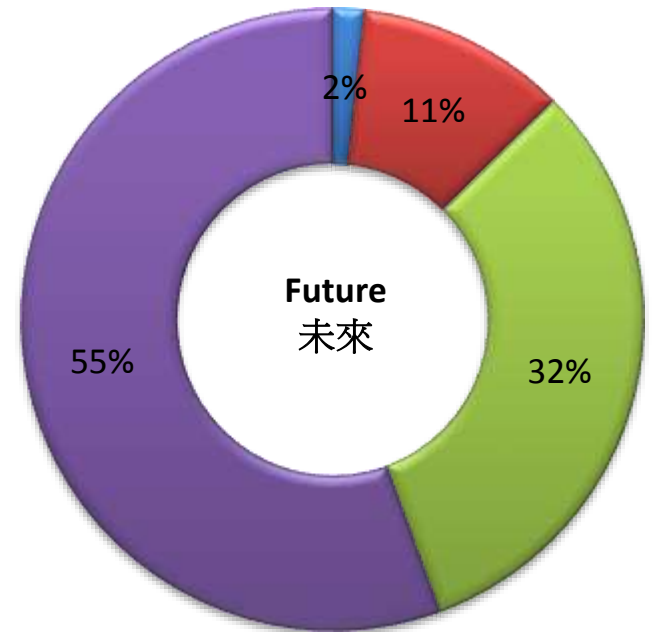
Source: 4C Offshore

- Most new projects are using 6MW to 8MW turbines
 - 大多數新計畫均採用6MW ~ 8MW渦輪機
 - Direct drive or geared turbines
 - 直接驅動或齒輪渦輪機
 - Starting to bring cost per MW down
 - 開始降低每MW的成本

Project size set to grow 計畫規模預定成長

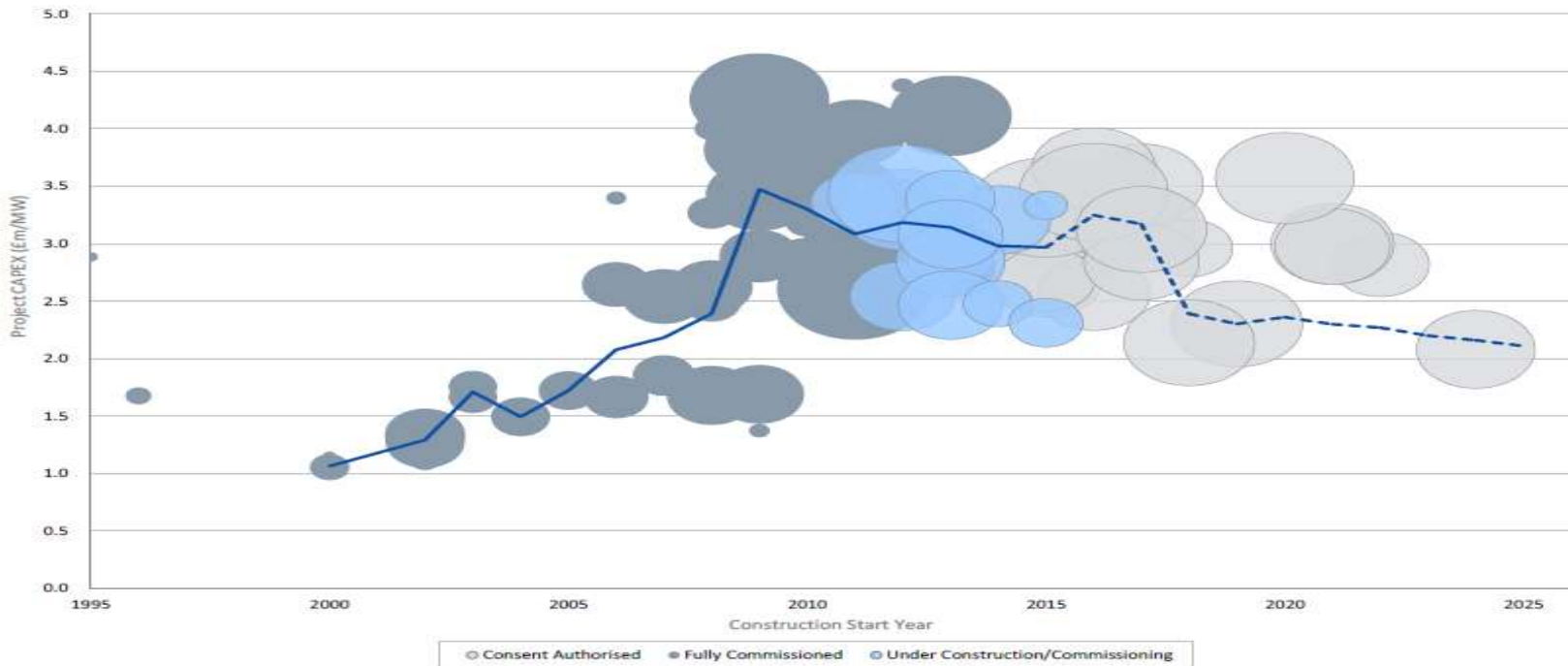


- <100MW
- 100MW to 250MW
- 251MW to 500MW
- > 500MW



Offshore wind cost development curve

離岸風電成本發展曲線



Early phase: Supply chain limitations + Raw material costs + Risk uncertainty = Increasing cost of generation

初期階段：供應鏈限制 + 原料成本 + 風險不確定 = 增加發電成本

Mature phase: Technology and project scale up + Greater supply chain competition + Reducing risk cost = Decreasing cost of generation

成熟階段：技術及計畫規模提升 + 供應鏈競爭增強 + 降低風險成本 = 降低發電成本

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Source: 4C Offshore

Implications of debt finance - how lenders perceive risk

舉債融資的意涵 – 貸方如何認知風險



- Energy yield
- 發電量
- Legal issues
- 法律問題
- Regulatory & tax regime 監管 & 稅制
- PPA 採購價格分攤
- Cost competitiveness
- 成本競爭力

- Experience & skills
- 經驗 & 技術
- Financial standing
- 財務狀況
- Ownership structure
- 所有權結構

- Time & cost schedule risk
- 時間 & 成本期程風險
- New technologies
- 新技術
- Interface risk
- 介面風險
- Supply chain management
- 供應鏈管理

- Limited track record
- 有限的過往紀錄
- Reliability
- 可靠性
- Maintenance
- 維護
- Availability
- 可利用性

Implications of debt finance - the impact on insurance design

舉債融資的意涵 – 對保險設計的影響

- Higher loss limits 較高的損失極限
- Lower deductibles 較低的免賠額
- Delay in Start-Up and Business Interruption covers obligatory
- 延遲完工和營運中斷保險範圍義務
- Terrorism cover required 保險範圍必須涵蓋恐怖主義
- Full design cover for Balance of Plant 電廠輔助設備完全設計保險範圍
- Design cover for turbines dependent on breadth and robustness of warranty
- 渦輪機之設備保險範圍取決於保固之寬度和強度。
- Longer periods of cover preferred to increase cost certainty
- 最好採取較長期保險範圍，以增加成本確定性。
- Lenders Insurance Endorsements 貸方保險批單

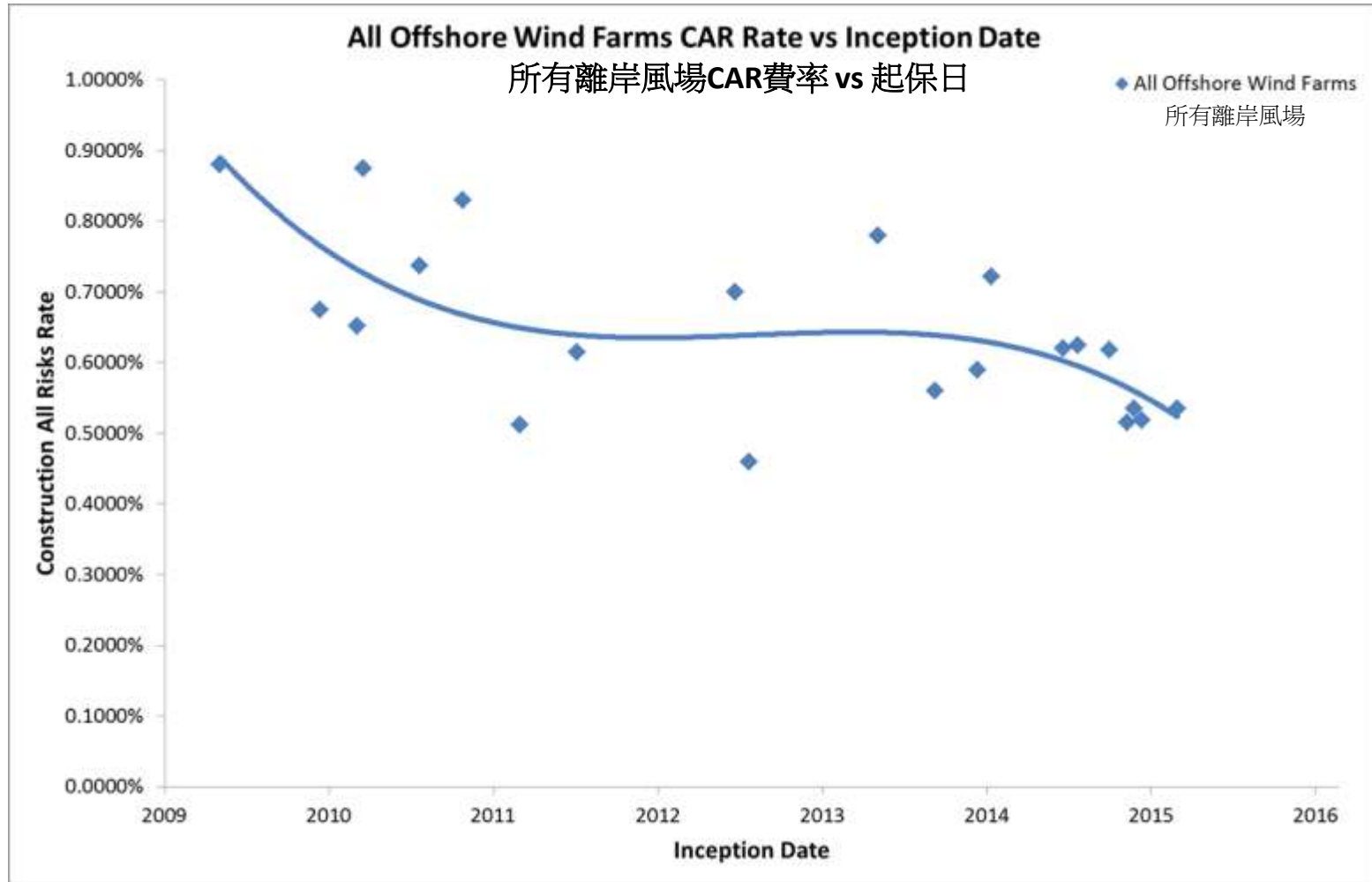
Implications of debt finance - lessons learned

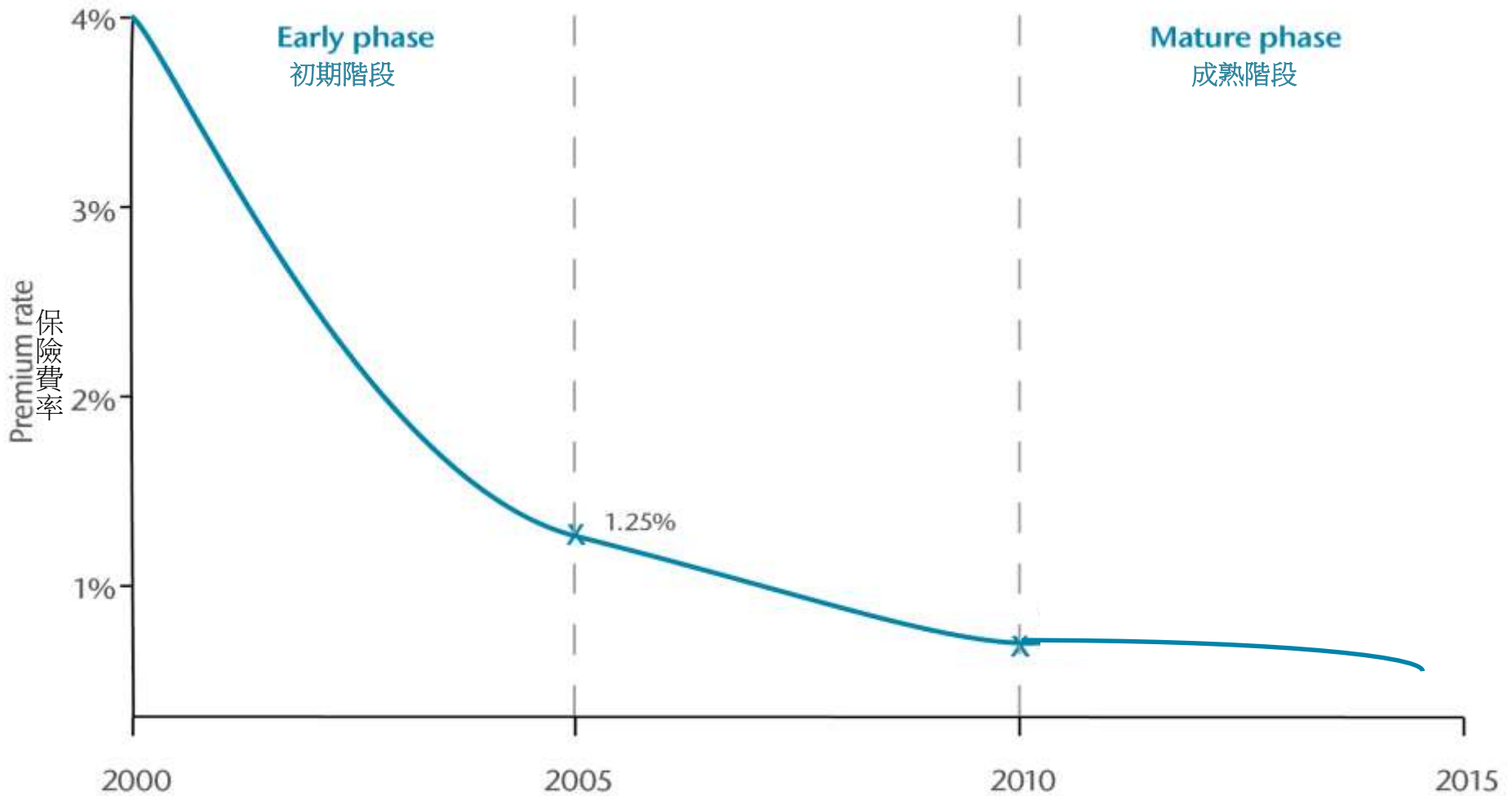
舉債融資的意涵－經驗與教訓

- Significant insurance due diligence undertaken
- 已展開重要保險盡職調查
- Time consuming 曠日費時
- Ensure fair insurance obligations under Finance Agreement
- 透過融資協議，確保公平保險義務。
- Ensure insurance compliance in all project contracts
- 在所有計畫合約中，確保保險遵從。
- Provide robust and long term insurance cover where possible
- 儘可能提供強韌而長期的保險範圍。
- Financially secure counterparties A- or better credit ratings
- 財務穩定的對手或更好的信用評級。
- Broader cover, lower deductibles, higher limits – higher insurance costs
- 較廣的保險範圍、較低的免賠額、較高的極限 – 較高的保險成本

European Construction premium pricing benchmarks

歐洲施工之溢酬訂價基準





Insurance programme design

保險計畫設計

- The key influencing factors: 關鍵影響因素
 - Risk analysis and loss scenarios – including technology and natural perils
 - 風險分析和損失情境 – 包括技術和天災
 - Legal framework for grid connection and transmission
 - 電網連接和輸電之法律架構
 - Contractual obligations 合約義務
 - Financing arrangements 融資安排
 - Ownership structures 所有權結構
 - Ability to leverage existing corporate insurance relationships
 - 利用既有的公司保險關係的能力
 - Availability and cost of insurance capacity
 - 承保能力之可供性和成本
 - Risk appetite 風險胃納
- Design insurance programme to the specific risk features of project
- 根據計畫之風險特性設計保險計畫。

A European insurance programme approach

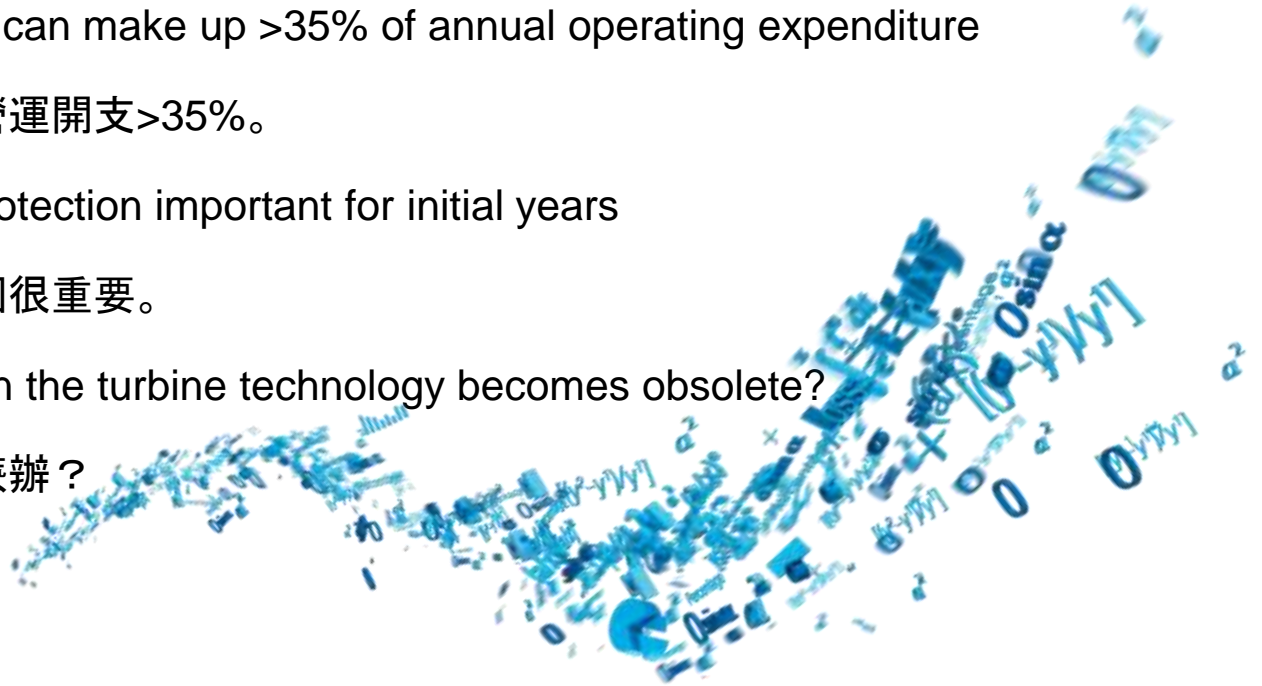
一種歐洲保險計畫方法

Phase 階段	Cover 保險種類	Responsibility 責任	Parties covered 涵蓋方
Construction 施工	Construction All Risks (CAR) including Marine Transit and Terrorism 施工全險(CAR), 含海上運輸和恐怖主義	Principal 被保險人	Principal, all contractors, technical advisors, any lenders 被保險人、所有承包商、技術顧問、貸方
	Third Party Liability (including marine liability) 第三方責任險(包括海上責任)	Principal / Contractors 被保險人 / 承包商	Principal, all contractors, technical advisors, any lenders 被保險人、所有承包商、技術顧問、貸方
	Delay in Start-Up (DSU) including Marine DSU and Terrorism 延遲完工保險(DSU), 含海上DSU和恐怖主義	Principal 被保險人	Principal and any lenders 被保險人和貸方
Operating 營運	Operating All Risks including Machinery Breakdown 營運全險, 含機具故障險	Principal 被保險人	Principal, Maintenance contractor, any lenders 被保險人、維護承包商、貸方
	Business Interruption (BI) 營運中斷保險	Principal 被保險人	Principal and any lenders 被保險人和貸方
	Third Party Liabilities 第三方責任險	Principal 被保險人	Principal, Maintenance contractor, any lenders 被保險人、維護承包商、貸方
General 一般	Employer's liability / Workers Compensation 雇主義務 / 工傷賠償險	Each party 各方	For their own interests only 僅涵蓋本身利益
	Motor liability 汽車責任險	Each party 各方	For their own interests only 僅涵蓋本身利益
	Contractor's plant and equipment 承包商廠房和設備險	Contractor 承包商	For their own interests only 僅涵蓋本身利益
	Professional indemnity 專業彌償保險	Designers 設計師	For their own interests only 僅涵蓋本身利益
	Charterer's liability 租船人責任險	Chartering party 租船方	Liabilities related to the chartering party 租船方相關責任
	Hull & Machinery 船體 & 機具險	Vessel owner 船主	Vessel owners' property 船主財產
	Protection & Indemnity 防護 & 彌償保險	Vessel owner 船主	Vessel owners' liabilities 船主責任
	Vessel construction 船舶施工險	Yard or owner 堆場或業主	Construction of hulls 船體施工
	Plant & Equipment 廠房 & 設備保險	Contractor 承包商	For their own interests only 僅涵蓋本身利益

Insurance lessons learned

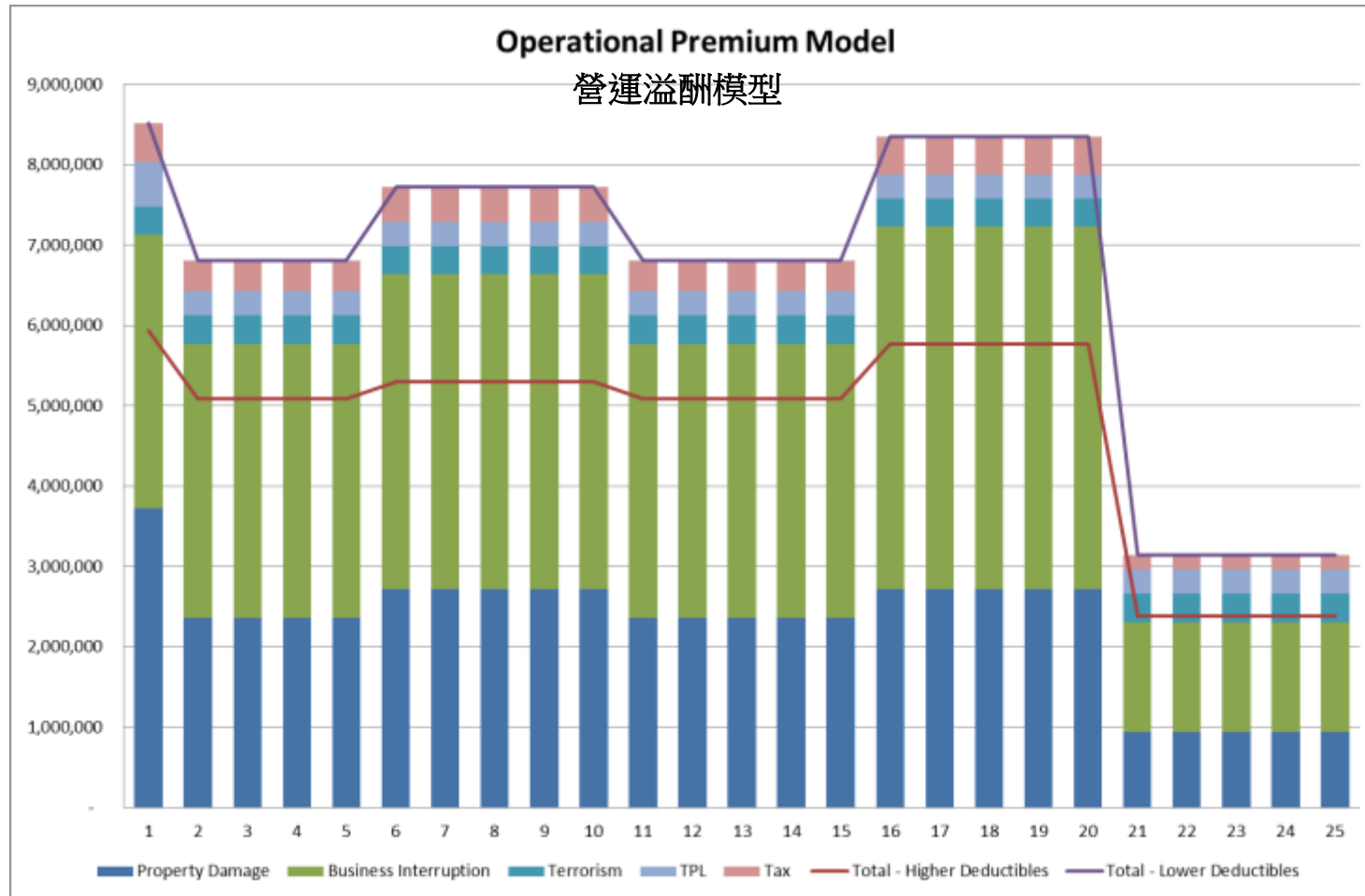
保險經驗與教訓

- Insurance cost has a significant impact on CAPEX and OPEX models
- 保險成本對CAPEX和OPEX模型有重大影響。
- Insurance premium can make up >35% of annual operating expenditure
- 保險費可能佔每年營運開支>35%。
- Turbine warranty protection important for initial years
- 最初幾年渦輪機保固很重要。
- What happens when the turbine technology becomes obsolete?
- 渦輪機技術過時怎麼辦？



Operating premium pricing models

營運溢酬定價模型



Claims experience

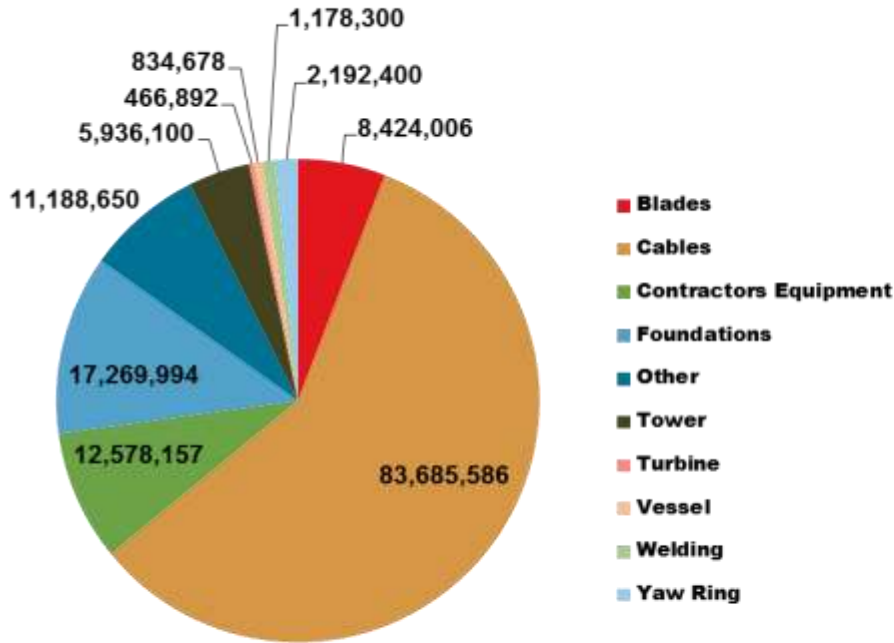
理賠經驗

Root causes usually include: 根本原因通常包括:

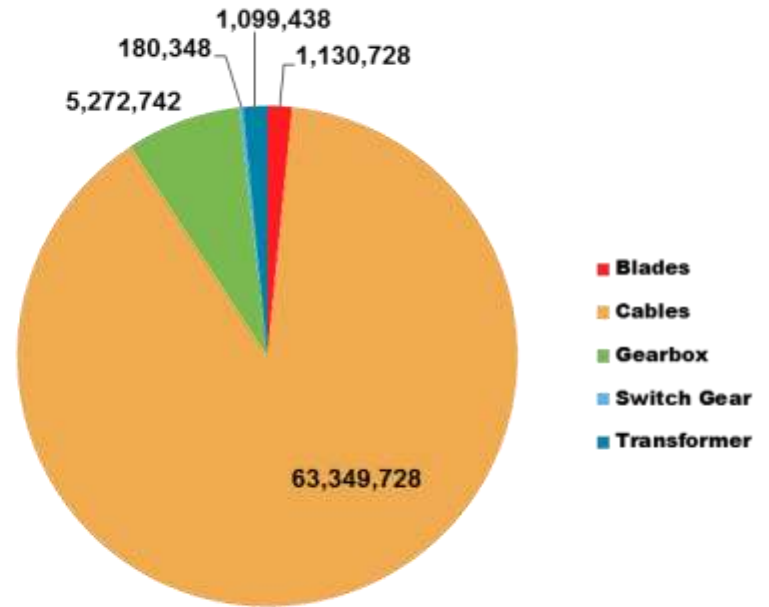
- Inexperience of Contractors and/or Suppliers 承包商或供應商經驗不足
- Unsuitable equipment and supply chain limitations 不當設備和供應鏈限制
- Defective Design 設計不良
- Limited quality assurance 品質保證有限
- Difficult offshore working conditions 離岸工作情況困難
- Inadequate working methodologies and contingency planning
- 工作方法不當和權變計劃
- Deviations from the methodology 方法導致偏差
- Significant waiting on weather costs 龐大的等候天氣成本

Offshore wind loss data

離岸風場損失數據



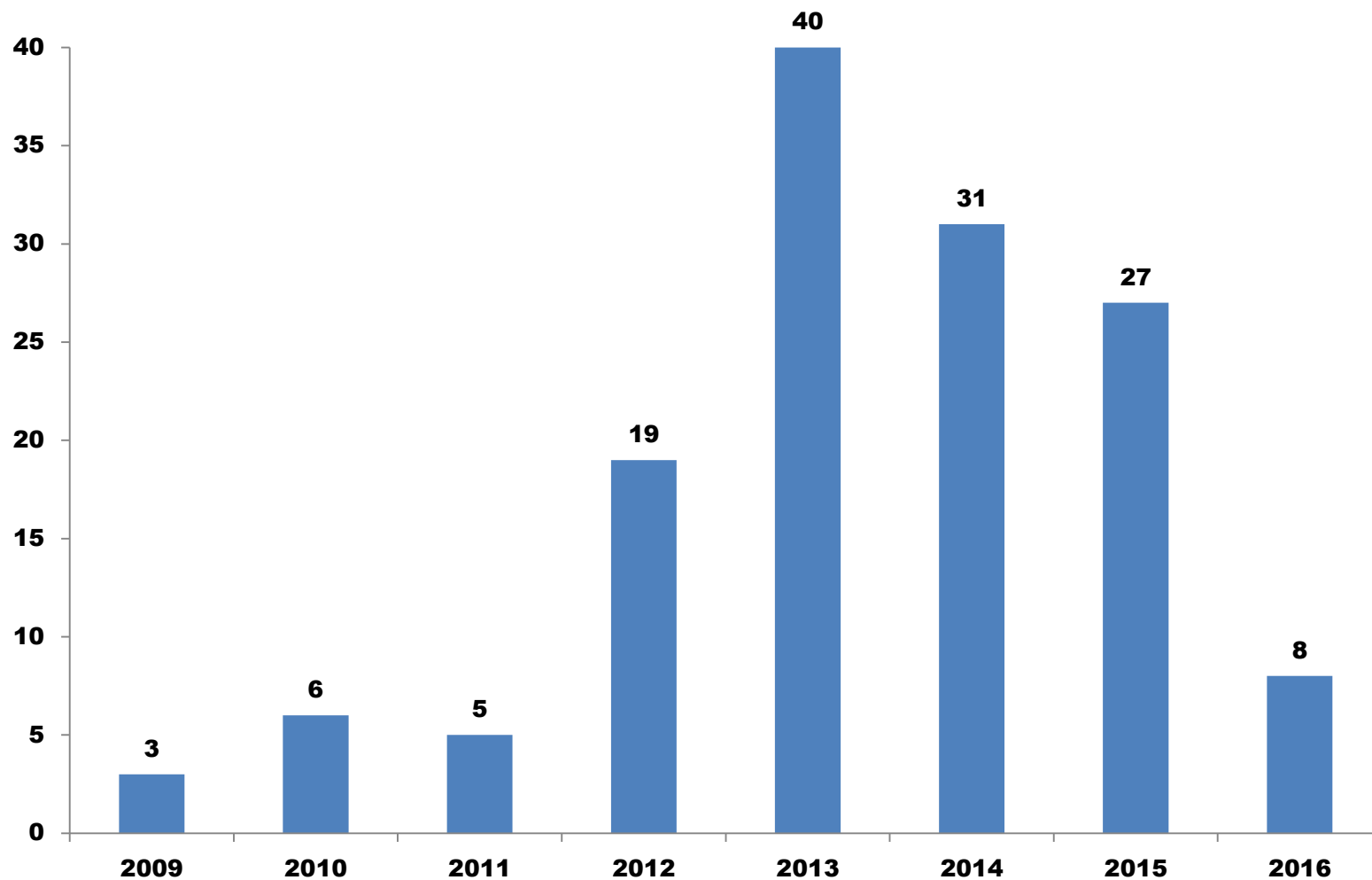
CAR Claims
施工全險理賠



OAR Claims
營運全險理賠

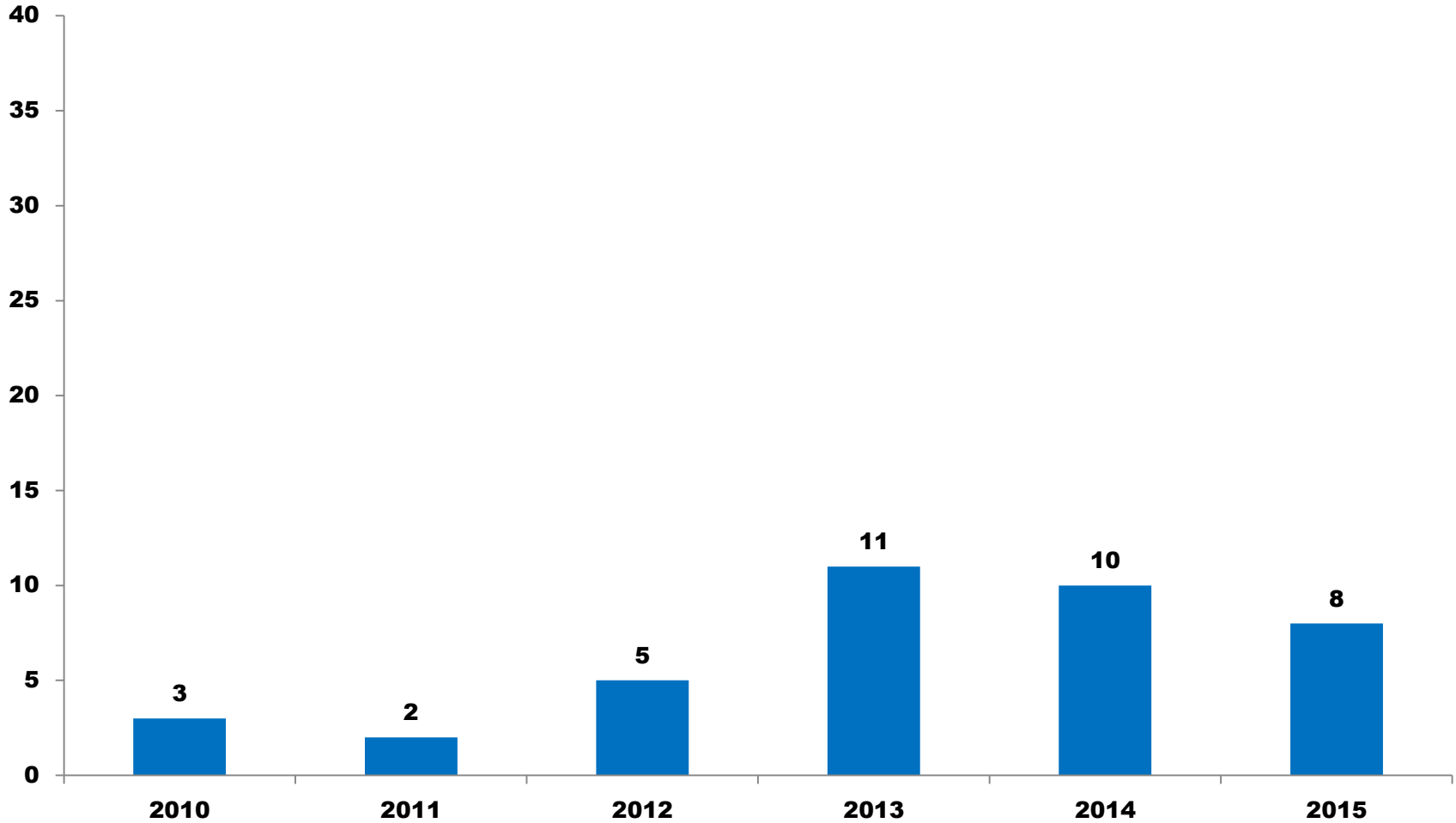
Construction Claims: Number Notified Per Year

施工理賠：每年通知數量



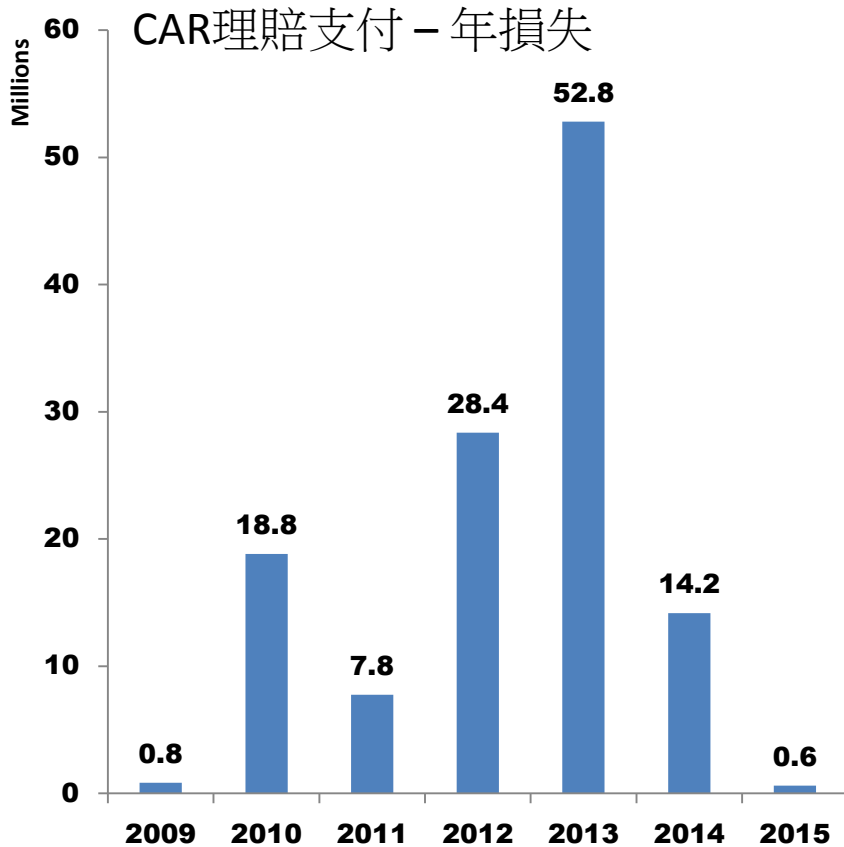
Operating Claims: Number Notified Per Year

營運理賠：每年通知數量

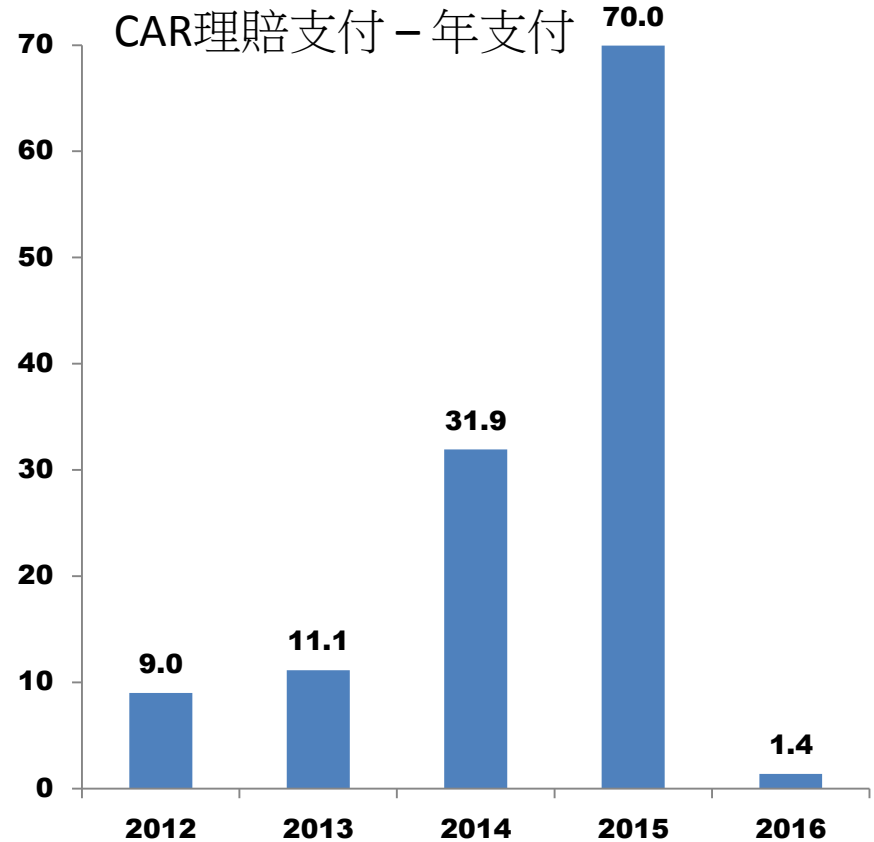


Construction Claims: Paid 施工理賠：支付 (2009 – 2016 NET USD) (2009 – 2016 淨額美元)

CAR Claims Paid - By Year of Loss

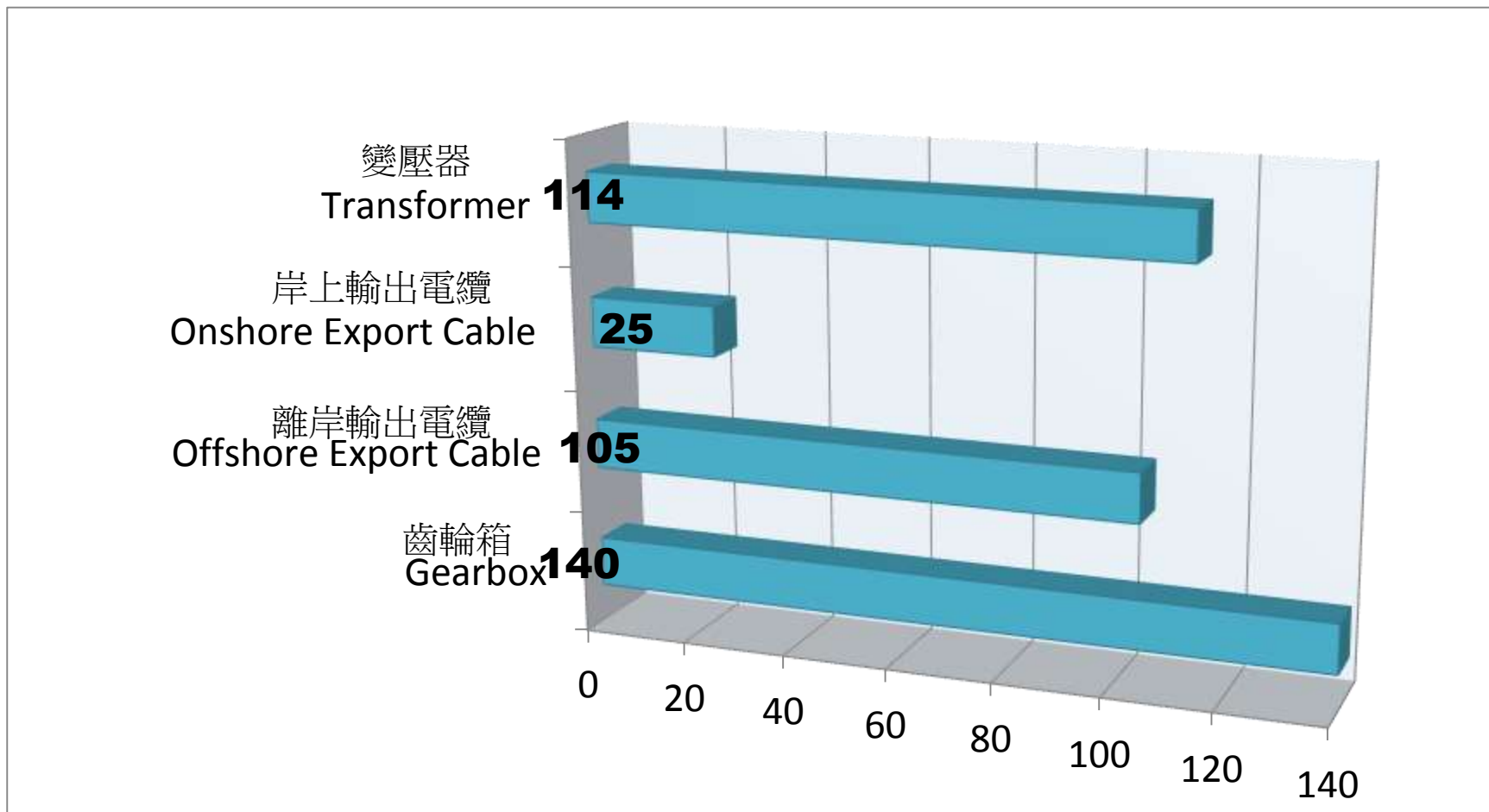


CAR Claims Paid – By Year of Payment



Business Interruption Claims: Average Number of Days Down (2009 – 2016)

營運中斷理賠：平均停機天數 (2009 – 2016)





Thank you