

出國報告（出國類別：開會）

第 17 屆臺英再生能源圓桌會議  
暨訪問團

服務機關：台灣電力公司

姓名職稱：王平貴（計畫經理）

派赴國家/地區：英國

出國期間：111 年 9 月 9 日至 9 月 17 日

報告日期：111 年 10 月

## 摘要

為推動臺英雙方再生能源技術交流與合作關係，自 2006 年起經濟部與英國貿易文化辦事處（BTCO）合作舉辦之「臺英再生能源交流合作圓桌會議」，藉由圓桌會議中探討雙方未來合作方向，並透過雙方互訪行程深化雙方產、官、學、研在再生能源領域上之交流，迄今已歷 16 屆，前兩屆因受疫情影響採視訊方式進行雙方討論，有鑑於近來疫情趨緩，今年度由經濟部能源局再次組團，參加第 17 屆臺英再生能源圓桌會議暨訪問團，本次議題聚焦「港埠設施」、「人才技術培訓」及「浮動式風力」等，透過雙方面對面的討論及交流，進一步促進雙邊合作並提升國內產業發展。

另考量英國為全球浮動式風電技術之領先者，本次訪問團同時規劃安排參訪英國 Kincardine 浮動式風場及其相關產業鏈等，汲取英國推動浮動式風場開發之經驗及技術等，作為國內即將推動浮動式離岸風力示範案及規劃相關政策之參考。

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## 附錄

## 壹、目的

本次係配合經濟部能源局組團參加於英國舉行之「第 17 屆臺英再生能源圓桌會議暨訪問團」，除延續前幾屆臺英雙方針對再生能源議題辦理技術交流外，另政府目前正積極推動浮式離岸風力示範計畫，本次也透過英國貿易文化辦事處（BTCO）的安排，參訪位於蘇格蘭東北方亞伯丁郡外海 kincardine 浮動式離岸風場，該風場為世界上最大的浮動式示範風場，藉由該次參訪對該示範案前期的規劃、營運現況及相關碼頭基礎設施等，有初步的了解，台電公司雖然積極參與離岸風場的建置，但其基礎型式皆採用固定式，對於固定式風場開發趨近飽和及面臨開發水域越來越深的情況，浮動式基礎應該是未來的主流開發模式，也希望借鏡國外浮動式風場開發的經驗，讓我們能夠縮短學習的曲線。

另外本次也安排了參訪英國離岸相關產業界，包含技術顧問、海纜保護裝置、水下探勘等，了解國外廠商的新製程及新技術，透過深入的經驗分享與意見交流，進一步促進雙邊合作並提升國內產業發展。

## 貳、過程

### 一、訪問團成員

本次出訪團係由經濟部組團，結合國內產、官、學等各領域之代表共 16 人，出席第 17 屆臺英再生能源圓桌會議及相關參訪行程，各單位出席代表人如表 1。

表 1：訪問團出席單位及代表人

單位/公司名稱	職稱	代表人
能源局	局長	游振偉
臺灣港務股份有限公司	臺中港務分公司總經理	陳榮聰
財團法人船舶暨海洋產業研發中心	執行長	周顯光
財團法人金屬工業研究發展中心	副執行長	王俊傑
財團法人工業技術研究院	綠能與環境研究所所長	王漢英

臺灣風能協會	理事長	簡連貴
英國在台辦事處	組長	蘇韻如
台灣電力公司	再生能源處主任	王平貴

## 二、行程概要

本次出訪主要是參加在倫敦所舉行「第 17 屆臺英再生能源圓桌會議」及參訪位於英國北部蘇格蘭亞伯丁郡外海浮動式離岸風場，另外安排拜訪當地商會及在地相關產業鏈等，相關行程如表 2。

表 2：參訪行程表

日期	行程概述
09/09~09/10	1. 去程: 臺北-倫敦 2. 內部工作會議
09/11	1. 拜會當地商會 2. 路程: 倫敦-蘇格蘭亞伯丁
09/12	1. 出海參訪 Kincardine floating wind farm 2. 與 Flotation Energy 公司進行會議
09/13	1. 與 Sulmara 探勘公司進行會議 2. 與國家除役中心 NDC 進行會議 3. 與 Balmoral 浮動式風場產業供應鏈業者進行會議 4. 與 ROVOP 浮動式風場產業供應鏈業者進行會議 5. 路程: 蘇格蘭亞伯丁-倫敦
09/14	辦理第 17 屆臺英再生能源圓桌會議
09/15	1. 與英國能源與船舶諮詢集團 ABL 進行會議 2. 與離岸風電技術諮詢公司 OWC 進行會議 3. 與英國創新局 Innovate UK 進行會議
09/16~09/17	1. 內部工作會議 2. 回程: 倫敦-臺北

參、主要參訪單位說明：

一、Kincardine Floating Wind Farm

Kincardine 浮動式風場位於蘇格蘭亞伯丁外海約 15 公里處，水深 60 至 80 公尺，此風場既計畫共分為兩期建置，第一期為示範機組採用 Vestas V80 2.0MW 一部，第一期主要作為浮動示風場前期試驗及驗證，擷取風機相關運轉資料及相關氣象海況資料，第一期風機在第二期完成安裝前已拆除，第二期採用 Vestas V164 9.5MW 五部，設置由 Principle Power 所設計的 WindFloat 半潛示平台上，該項計畫從 2014 年由 Allan MacAskill 和 Lord Nicol Stephen 開始規劃，直到 2016 年 Cobra Group 成為 Kincardine Offshore Windfarm Ltd (簡稱：KOWL) 的主要投資者，而 Cobra Group 的子公司 Cobra Wind 負責執行該項計畫，KOWL 風場不僅是世界上最大的浮動式風場，同時也安裝了目前單機容量最大的風力發電機組 (9.5MW) 於浮動平台上，總裝置容量約為 50MW，一年可產出超過 2 億度的電力，約可供給 5 萬多戶蘇格蘭家戶用電，有關第一期及第二期相關資訊如表 3 及表 4：

表 3：Kincardine Phase 1 相關資訊

1	風場名稱	Kincardine Phase 1
2	風場面積	1.18km <sup>2</sup>
3	風場離岸距離	15km
4	風場水深	60~80m
5	期初建置成本	23,000,000 英鎊 8億3千5百萬
6	裝置容量及機型	2MW*1/Vestas V80
7	基礎型式	Floating 1*Semi-Submersible Platform
8	風場經營者	Kincardine Offshore Windfarm Ltd
9	風場擁有者	Group COBRA
10	開發權取得時間	30/06/2014
11	施工許可取得時間	07/03/2017

12	開工時間	22/07/2018
13	併聯完工時間	24/10/2018
14	組裝基地	Aberdeen(UK) , Dundee(UK)

表 4 : Kincardine Phase 2 相關資訊

1	風場名稱	Kincardine Phase 2
2	風場面積	24.18 km <sup>2</sup>
3	風場離岸距離	15km
4	風場水深	60~80m
5	期初建置成本	400,000,000 英鎊 <span style="margin-left: 20px;">145 億</span>
6	裝置容量及機型	47.5MW , 9.5MW*5/Vestas V164
7	基礎型式	Floating 5*Semi-Submersible Platform
8	風場經營者	Kincardine Offshore Windfarm Ltd
9	風場擁有者	Group COBRA
10	開發權取得時間	30/06/2014
11	施工許可取得時間	07/03/2017
12	開工時間	16/09/2020
13	併聯完工時間	19/10/2021
14	組裝基地	Aberdeen(UK) , Rotterdam(NL)

3 億/MW

） 併聯時間？

### (一) 浮動平台的製造：

由西班牙國營公司 Navantia 於其位在 Fene 港的船塢生產製造半浮潛式水下基礎，再以拖船運至英國蘇格蘭的 Dundee 港，一般來說，目前常見的浮式風機的基礎製造，大概驟如下：

1. 先在碼頭後線場地上依序製作大直徑密封式鋼製圓柱浮筒
2. 浮沈式平台船先引入壓艙水座底至甲板與碼頭面齊高
3. 再以多輪車承載風機基礎移動至浮沈式平台船上
4. 平台船承載風機基礎航行至足夠水深水域
5. 再將平台下沉讓風機基礎起浮，必要時藉助浮力袋
6. 風機基礎起浮後再移至足夠水深之碼頭
7. 在碼頭邊座底整合安裝塔身及風機
8. 再起浮風機基礎由拖船拖至外海風場錨定



圖 1：Floating 製造、Load In 及 Load Out



## (二) 風機組裝

與傳統離岸風力組裝方式不同之處，浮式風力機組會在碼頭與浮動式平台組裝完成後再以拖船拉置風場與錨鍊結合。



圖 2：風機組裝及運輸

### (三) 錨與繫繩：

傳統離岸基礎係透過打樁方式固定，其基礎期施工過程中所產生的振動及噪音，長期受環保人士的關注，而浮動式載臺其固定方式有別於傳統固定式基樁，係藉由錨（Anchor）穩固於海床後，經繫繩（Mooring）連接水下基礎載臺。

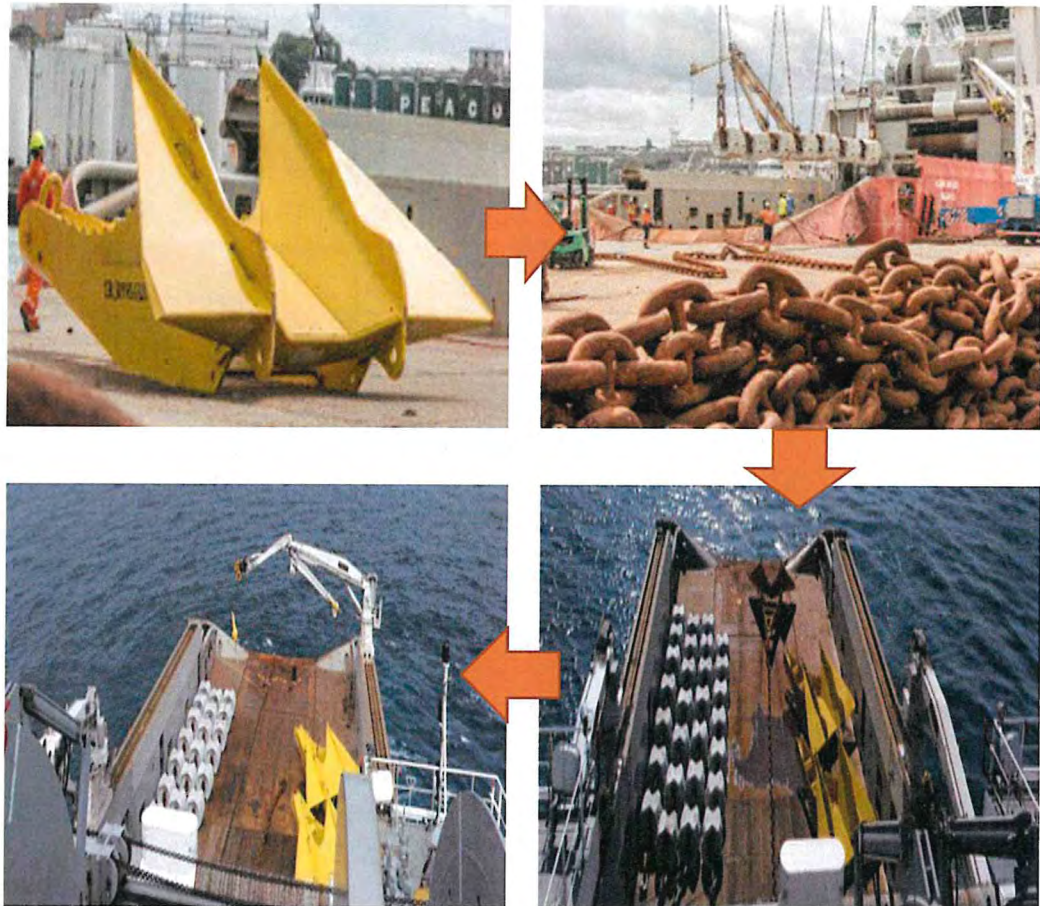


圖 3：錨與鋼鏈

## 二、Sulmara 水下探勘服務公司

Sulmara 公司總部位於 Scotland Glasgow，係專為離岸及能源等產業，進行海域相關調查及監測作業，主要服務內容包括海域調查作業、海纜安裝作業及離岸風場運維階段之監測作業。詳細服務內容如下：

### (一) 海域調查作業：

未爆彈調查、場域特徵調查、前端工程調查、水深調查及環境調查。

(二) 海纜安裝作業：

海床挖溝作業、埋設深度調查、海纜佈埋設及竣工圖繪製。

(三) 運維階段監測：

淘刷監測、海床及沙波監測、海纜位置監測及材料完整性調查。

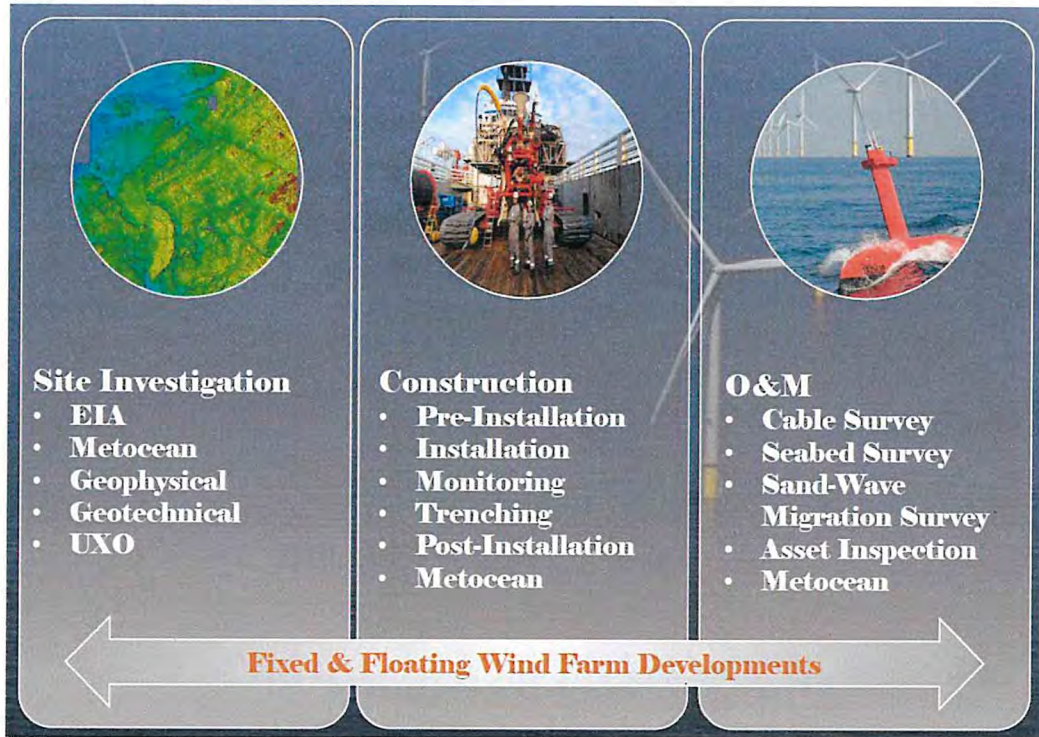


圖 4：Sulmara 公司目前服務項目

Sulmara 公司，已於 2021 年在台灣設立子公司（樹木旺再生能源有限公司），並結合國內相關海事工程公司，如：東方風能(DFO)及聯達行(Lian Tat)等，推動相關在地化工作，也承攬國內部分風場的調查工作，如：彰化大東南、彰芳暨西島、海鼎、海能等。

Sulmara 目前採用最新無人船進行水下調查並已以柴油為動力，最高航速 14 節，用途包括海洋調查、多音束水深測量、水下探勘等，一個風場約只需要兩個星期的工作時間即可完成作業成果，遠比目前國內調查廠商之作業期間節省 80% 以上，調查後的資料收集，可經由衛星遠端遙控、Star Link 低軌道衛星及 Light Band 等通訊系統進行遠端遙控及資料上傳，免除人員還需至現場擷取資料。



圖 5：Sulmara 公司無人載具

### 三、 Balmoral 電纜保護系統製造公司

Balmoral 集團成立於 1980 年，總部設於亞伯丁，Balmoral 集團主要係專為再生能源產業提供實驗室試驗、工程設計、產品製造及設備測試等多項服務，旗下包括 Balmoral Offshore Engineering、Balmoral Comtec、Balmoral Tanks、Balmoral Business Park 及 BLAZE Manufacturing 等公司，其中 Balmoral Offshore Engineering 著重於離岸風場及油氣產業之服務。專為固定式及浮動式風力機提供相關保護產品及浮力系統：浮具的密度控制，外殼保護，水下絕緣及耐久性，為該公司的主要競爭力，浮具係藉由保護外殼內加入類似保麗龍密度極低又具一定體積且不易被壓縮的圓形球體，再灌注液體入內凝固，即可提供具保護外殼且不易變形的浮具，控制保護外殼內圓形球體的數量及體積，即可控制浮具成品的密度，進而可由欲控制浮沈在海中的物體或電纜重量，設計浮具的使用樣式與數量，為世界上浮具使用的寡佔公司。詳細產品及服務內容如下：

(一) 固定式基礎：

Balmoral FIBREFLEX®海纜保護系統(CPS)、海纜喇叭口(Bellmouth)、J-tube、海底穩定性模塊、彎曲保護系統(Bend restrictors)及海纜疲勞與散熱分析。

(二) 浮動式基礎：

浮標系統、彎曲保護系統(Bend restrictors)、繫繩夾、錨鍊浮球、觸底保護系統、壓載系統、海纜扇形架及海纜疲勞與散熱分析。



圖 6：海纜保護系統



圖 7：海纜保護系統安裝

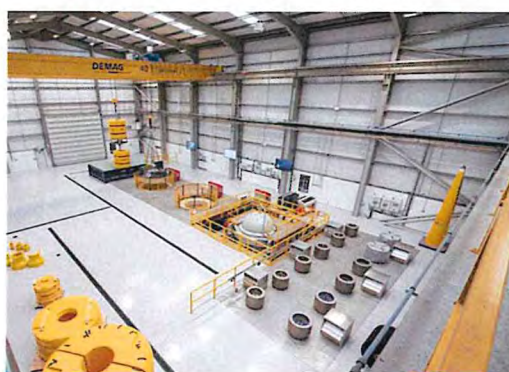


圖 8：CPS 測試中心



圖 9：CPS 測試塔

#### 四、英國國家除役中心(NDC)

英國國家除役中心(National Decommissioning Centre, NDC)係由蘇格蘭亞伯丁大學(University of Aberdeen)及淨零技術中心(Net Zero Technology Centre)共同合作成立之研究中心，由多位各領域之專家學者組成，致力於研

究及發展能源產業之除役工作(包含再生能源、石油天然氣及核能)，達到零排碳除役之能源轉型。主要針對除役作業中之排碳量、環境影響、經濟模型及整個風場系統進行研究。

## 五、ROVOP 水下載具技術服務公司

ROVOP 公司為水下無人載具(ROV)供應商，擁有超過 9 台專業水下無人載具。自 2011 年成立起，提供多個離岸風場、油氣產業及海底電纜工程之水下調查及施工支援等服務。主要服務內容包括：未爆彈調查、水下安裝監測及鑽油作業水下監測等，已於北海完成多個油氣平台除役作業監測、鑽油作業監測與調查，以及離岸風場之安裝作業監測。

該公司所提供的大型水下無人載具，其工作深度可達 70 公尺水深，使用 7 向機械手臂，機械手臂採用鈦合金，可減輕重量抗腐蝕及極高強度。為訓練專業人員及認證使用，該公司亦提供訓練用模擬機，水下模擬機操作擬真度高。



圖 10：大型水下無人載具



圖 11：訓練用模擬機

## 六、ABL 英國能源與船舶諮詢集團

ABL Group 是一家投資控股公司，為全球海上油氣業和海上可再生能源市場提供海事工程諮詢服務。該公司主要致力於降低能源產業和海事作業的開發風險，並推動石油和天然氣領域的能源轉型，同時從事離岸再生能源相關技術服務，其觸角涵蓋包括專案開發、顧問諮詢、技術盡職調查、大地工程相關和離岸移動式平台運輸評估服務。此外，該公司也針對海事工程、再生能源、石油和天然氣、離岸基礎設施等相關產業提供相關設計及評估服務。

另外 ABL 集團為世界性的跨國認證公司主要有專案驗證及 MWS，與 DNV 為世界前二大認證公司，其主要角色在作為開發商（業主）與製造施工方之間的協調，代表業主針對製造施工方，其完工的成果是否符合業主需求進行認證，認證範圍包括規劃設計內容、施工過程、完工驗收、營運、後續維護管理等，沒有經過 ABL 認證，業主及提供融資方不會同意開始施工、組裝運送、或接管營運，很類似公共工程專案管理的角色。

認證方式主要是以書面審查，並針對製造施工方的書面資料及文件審查背書認證。例如規劃內容及結構計算是否合法規及業主需求、設計內容是否與現場調查結果相符、完工內容是否符合設計要求等，惟至於施工及探勘過程等現地實質作業內容，是施工及製造方其專業技師應該負責任，ABL 不再重新鑽探，亦不會去重新水下測量或調查，惟 ABL 可應業主需求針對施工過程與水下基礎之焊接、鎖螺栓、吊裝、運送等現場作業進行抽驗或監看；該公司目前亦承攬本公司離岸二期海事保證鑑定（Marine Warranty Survey, MWS）之工作，MWS 的許可認證包括工程及程序文件許可、船舶及設備文件許可、環境保護許可、氣候條件許可、零組件裝載許可、運輸許可、離岸安裝許可、操作及營運許可。

ABL 的服務範圍上述驗證工作外，ABL 集團所屬子公司 OWC 離岸風電諮詢顧問公司，OWC 提供了包括選址評估、環境管理、合約規劃、需求研擬、現地調查、風機選定、細設審查、型式認證、電網連結，一直到風機製造、塔身組裝、水下基礎等施工監看與施工管理，風險管理、安全管理、運送及工廠管理，保固、營運及維護期間支援等風電產業一條龍式的服務，2018 年在台灣也設立海上風電諮詢有限公司，為 OWC 在海外人數最多及營業額最高的海外分公司。

ABL 簡報展示了浮式風機基礎在船塢製造完成之後運送上船的過程可區分為尾靠及側靠，可由天車運送至碼頭面，再由吊車或多輪車運送上船。會中港務公司出席代表表示，高雄港 A6 風電專用碼頭，是國內唯一可同時提供側靠及尾靠裝卸作業的碼頭，在增加少數有限的建造成本，充分利用沈箱式碼頭的特性與巧思，即可提供 410m 側靠及 78.4m 尾靠的 30T/M<sup>2</sup> 重件碼頭。



圖 10：尾靠 Load Out

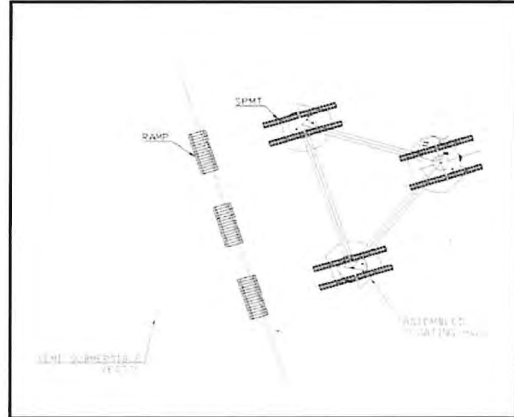


圖 11：側靠 Load Out

## 七、英國創新局 (Innovate UK)

英國創新局 (Innovate UK) 是英國的創新及研發機構，它為一些新創產業提供資金和技術協助，以培養並扶植英國本地的創新產品或技術服務。該機構的本質為英國研究與創新部的分支機構，它是一個非政府部門但具官方色彩的單位。

英國政府的願景是到 2035 年，英國能成為全球創新技術的中心。因此該機構為實現這一政策目標，其存在價值便是協助在地產業能經由創新產品和創新技術的開發，進一步達到具商業化價值的規模，並能輸出其成果到全球各地。

該單位經由直接撥款或提供貸款等方式，為特定在地創新產業提供資金，除了協助其獲得所需的專業知識和設備外，還另協助盤點並建置有利於成長的產業鏈。而為了避免壟斷，該單位秉持自由和公平競爭來選定最適合的產業扶植。

## 肆、第 17 屆臺英再生能源圓桌會議

### 一、議程 1：臺英雙方引言簡報

臺方首先由能源局黃韋智科長，針對「台灣淨零排放過程及離岸風力政策」主題做簡報說明，內容包含台灣淨零排放過程、光電及離岸風力推動進



展等，我國於 2016 年公布能源轉型，能源局大力推動再生能源的建置，預計 2025 年完成 29.4GW 裝置量體，其中以太陽光電及離岸風電為主要推動目標，佔整體再生能源量體 87%，台灣政府也在今年（2022 年）3 月宣布 2050 年達成淨零排放目標的政策，包含 4 項轉型策略、2 項重要施政及 12 項重點推動項目等；再生能源建置部分，2025 年完成太陽光電 20GW（地面型：12GW 及屋頂型：8GW）建置，離岸風電共分為三個階段推動，Phase 1 示範風場已建置完成，Phase 2 鄰選場址正施工中，2025 年累計裝置容量可達 5.6GW，目前正在推動 Phase 3 預計今年底完成第一期選商，規劃在 2035 年完成累計裝容量 20.6GW 之建置，另外面臨近海區域風場開發飽和，逐步往深海區域開發，亦同步規劃浮動式風場示範案，預計 2023 年完成選商，2026 年完成併網。

英方由英國皇家財產署（The Crown Estate）海洋局局長 Huub den Rooijen 進行簡報，主要說明英國目前最新的策略，包含：零碳的趨勢、嶄新的社區及友善環境等，為達成零碳的要求，英國政府分別在 2030 及 2050 年提出相關的目標，2030 年完成 50GW 離岸風力的建置（包含 5GW 浮動式風力）、每年約 10Mtons 的碳儲存及開發約 10GW 的氫能，2050 年完成超過 95GW 離岸風力建置、每年超過 100Mtons 的碳儲存及 開發約 35GW 的氫能。

英國近期也積極開發浮動式離岸風力，包含本次參訪 Kincardine Offshore Wind Farm，並且提出相關推動策略：

- （一） 4GW 中的 1GW，擬採分階段或漸進階梯式開發。
- （二） 提供開發商投資和發展機會，並加強相關基礎設施之合作如：碼頭或電網等。
- （三） 目前英國西南側所規劃的 5 塊開發區域，將進一步劃定成浮動式專案開發區。
- （四） 與印度塔塔集團尋求一系列投資及行動，已加速浮式風場的興建。
- （五） 調整及修正場址的設計與相關法規。

## 二、議程 2：離岸風電供應鏈-海洋運維服務

本項議題由臺方工研院綠能所副研究員楊哲一及英方 James Fisher 運維

公司策略發展經理 Mike Hodgson 進行簡報，楊副研究員說明臺灣發展離岸風電的同時，也積極提升國內相關海事工程量能，在政策上透過產業關聯的推動，要求開發商須優先採用國內海事工程廠商或國內公司持有股權超過 50%的合資海事公司，也因此政策目前國內有超過 20 家的海事工程廠商（如：環球測繪、宏華、東方風能及台船環海等）獲得開發商的合同，量能逐步擴展中；另各開發商也因應未來風場建置完成後之營運，為維持風場正常運轉，已著手規劃相關的運維中心的建置。

英方 James Fisher 再生能源公司 Mike Hodgson 經理，說明該公司為一家的運維公司，主要提供風場 BOP (Balance Of Plant) 運維服務（包含海陸高壓設備檢測、ROV 服務等服務項目），在國外有非常多的實績，著名的 London Array 風場也是由該公司提供運維服務，目前在國內也與其他海事工程廠商合作。

### 三、議程 3：港埠基礎建設與管理

本項議題由臺灣港務股份有限公司高雄港務分公司副總工程師鄭智文及英方 Arup 公司處長 Borbala Trifunovics 進行簡報，鄭副總工程師說明該公司為國營事業，積極配合政府離岸風電政策，目前已在北、中、南主要港口設置製造、預組裝及運維之碼頭供相關產業使用，台北港及高雄港主要作為水下基礎製造基地，目前主要有世紀鋼鐵及銘榮源等多家廠商進駐，台中港目前有 #2、#5A、#5B、#36、#37 及 #38 等碼頭，作為風機預組裝基地，另在鄰近的腹地提供離案相關產業進駐，目前已有天力、永冠、華城電機及西門子等廠商設廠生產中，在運維部分亦規劃台中港、布袋港及安平港作為後續風場運維基地，港務公司也與其他公司共同成立 GWO 訓練中心，提供相關 HSE 的課程，培養離岸風力之技術人才。

英方 Arup 公司處長 Borbala Trifunovics，針對製造、儲存及運維等階段所需碼頭，提出相關的規格需求、費用及風險等項目說明，另針對固定式及浮動式基礎碼頭規格之差異亦作說明。

表 5：固定式及浮動式基礎碼頭規格

Fixed Wind	Floating Wind
<b>Port Area (not including foundation storage)</b>	
<b>23 ha</b>	<b>29 ha</b>
<b>Foundation Storage</b>	
<b>6 ha (dry)</b>	<b>40-50 ha (wet) or 25 ha (dry)</b>
<b>Quay Length</b>	
<b>500m</b>	<b>550m</b>
<b>Quay Depth</b>	
<b>12m</b>	<b>15m</b>

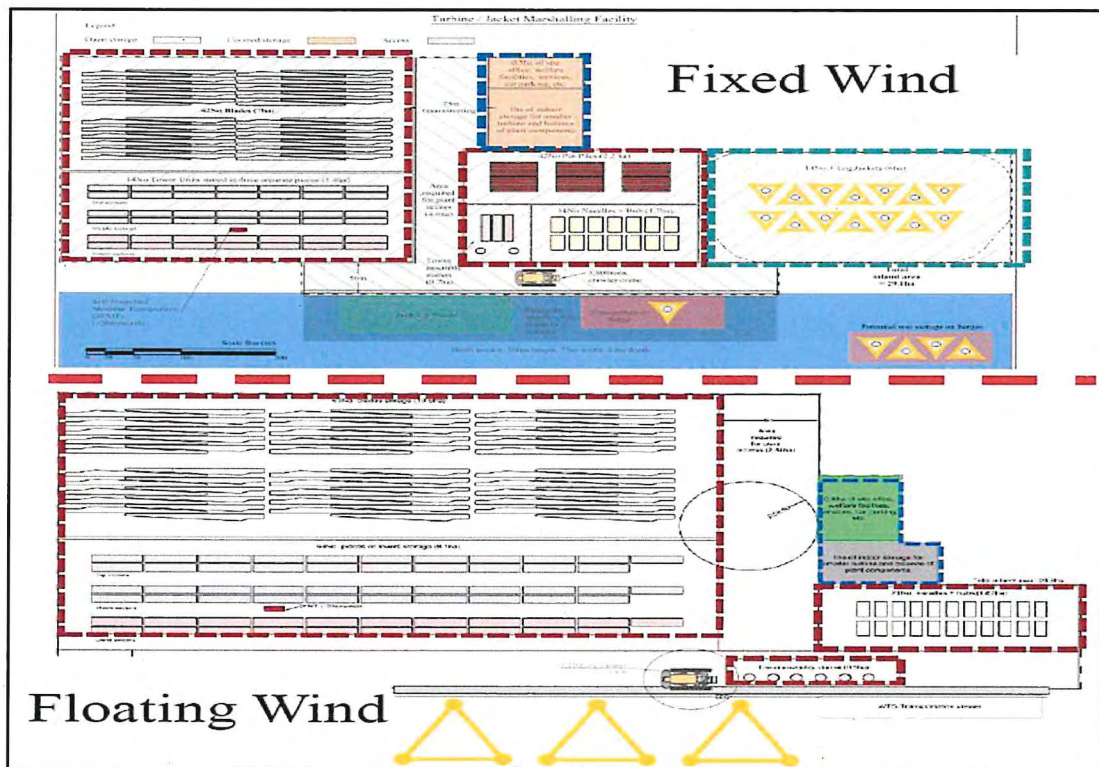


圖 12：固定式及浮動式基礎碼頭布置圖

另外在運維部分，該公司亦說明 CTV 與 SOV 用途差別，相關規格。

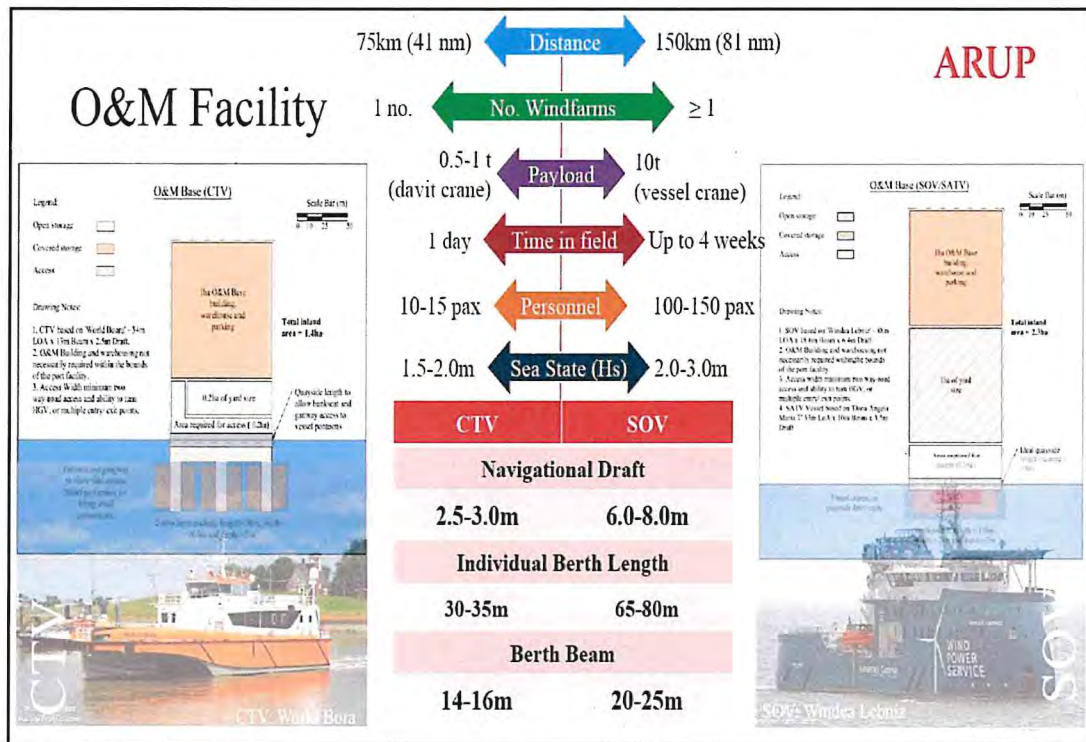


圖 13：CTV 與 SOV 運維船隻用途比較

#### 四、議程 4：離岸風電人才技術培訓

本項議題由金工中心海洋科技產業創新服務處副處長陳維德及英方 Opito 公司副總經理 Andy Williamson 進行簡報說明，陳副處長說明由於離岸產業逐漸成型，技術人才之需求也與日俱增，為培養相關之人力，金工中心與 OPito 合作，於 2020 年 1 月在高雄興達港已成立海事技術創新中心，包含海事技術研發部門、海上逃生訓練部門及離岸設計部門等，其目的除培養技術人力外，另結合國內相關海事工程廠商，針對海上實務操作能直接落實於課堂上之訓練，以無縫接軌之方式，提供產業界技術人力之需求。

#### 伍、心得及建議

##### 一、心得

很榮幸代表台電公司參加第 17 屆臺英再生能源圓桌會議暨訪問團，透過本次的意見交流讓雙方兩國能夠更深入地了解各自再生能源的發展現況，離岸風電在台灣經過政府兩階段的推動，已有初步的成果，英國針對離岸風電的

推動時程遠比台灣早數十年，除了穩健的推動固定式風場外，面臨更深的水深亦已完成多個浮動式示範案場且已併聯商轉中，透過本次參訪 Kincardine Floating Wind Farm，讓我們對浮動式基礎設計有初步的了解，也讓我們看到亞伯丁港對離岸運維港整體的規劃，相較之下未來國內彰化漁港，在基礎建設仍未完備前，仍有一段漫長的路要走；另外在重件碼頭部分，有別於固定式的安裝方式，浮動式基礎須於碼頭邊完成與風機的組裝，再靠拖船拖運至風場與錨鍊連結，惟目前國內港務公司所規劃的重件碼頭都是以風機預組裝來做規劃，若未來要推動浮動式風場，勢必要重新再規劃能夠同時處理基礎及風機之組裝。

另外本次也有機會能夠參訪在地離岸風電產業之供應鏈，英國已推動離岸風力數十年，相關產業鏈建置及政策已非常成熟，對於目前政府所推動產業關聯政策也有許多可借鏡之處，而人才培育的部分，英國政府也與多個大學合作，從學生的基本功做起，在求學的階段即逐步與未來工作同步接軌，不會有斷層的情形發生，相較國內大學部分，雖然有台大、成大及海大等學校仿效，由於國內薪資結構的問題，短時間要達成人才培育的目標，仍有一段漫長路要去推動與執行。

雖然國內離岸風電起步較晚，但由於政府的政策明確及落實，且借鏡相關國家的經驗，在配合國內整個基礎建設逐漸完備，未來的離岸風電將是國內再生能源的主力，而國內相關產業之技術及量能，勢必也因此提升茁壯，期許台灣離岸風電能再創第二個半導體產業之榮景。

## 二、建議

再次感謝能源局及英國在台辦事處精心安排此次的行程，台電以離岸風電開發商及穩定供電的角色，參與此次的訪問團，收穫最多的當然是參訪 Aberdeen 的浮式離岸風場，讓我們初步了解 Floating 相關的建置流程。

然而台電目前有 2 個風場，一個在運維中，另一個在施工中，面對未來風場的「營運階段」是一項重要的挑戰及課題，建議在下一次的行程中，能夠增加風場營運規劃的項目，包含：營運中心的建立、風場監控系統的設計、

運維船隻調度排程、風機及 BOP 的營運策略等項目，因為未來風場營運的好壞，攸關台灣每年 200 億度（以 2025 年 5.7GW 建置容量計算）的綠電供應，也是未來台電是否能正常調度風場的重要因素。

# 附 錄





# FLOTATION ENERGY



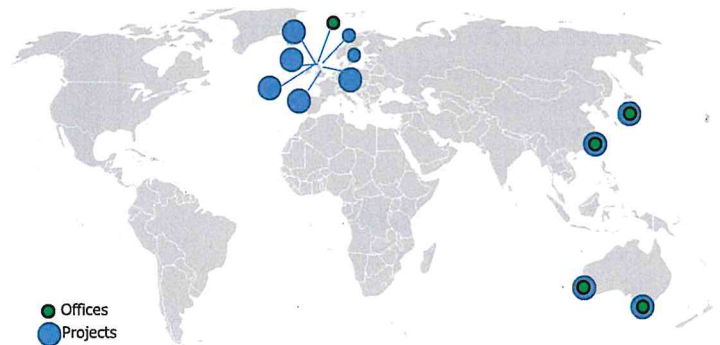


SDI Taiwan UK Mission, 12 September 2022

## Flotation Energy



- Global leader in floating wind development
- HQ in Scotland with subsidiaries in Taiwan (福廷綠能源股份有限公司), Japan (フローテーションエナジー株式会社) & Australia
- Global team of 50 and rising
- Proven track record of developing and delivering 3GW of floating and fixed offshore wind
- Our team developed Kincardine – the world’s largest floating windfarm
- 16GW portfolio of projects
- Developing 100 to 500MW floating offshore windfarms in the UK with FID 2025
- Committed to delivering floating offshore wind in Taiwan



# What we offer

## Our unique value proposition

- A committed valued team
- A team with global leading experience in floating offshore wind development and delivery; and a proven track record of decarbonising the oil and gas industry
- Our team came up with the concept, engineered, consented and delivered the construction phase of Kincardine and secured funding from Joint Venture Partners
- Familiarity with Oil and Gas and a track record in delivering electrification and integrating it with wind power
- Relationships with the supply chain that allow us to work with manufacturers to meet specific project needs
- A solution which allows rapid partial decarbonisation of oil and gas platforms
- Innovation in finding routes to market that do not depend on a grid connection



## White Cross: Project Overview



### Site Characteristics:

- Project Location: Celtic Sea
- Project Area : 50km<sup>2</sup> (2MW/km<sup>2</sup>)
- 50km off NW coast of Devon/Cornwall
- Water depth of 60m – 80m
- Located outside of marine protected areas
- Average wind speed >10m/s

### The Crown Estate Application:

- Applicant: Offshore Wind Ltd
- Capacity: up to 100MW
- 8 x 12MW WTGs
- 8 x Floating substructures

### Current Project Status:

- The Crown Estate acceptance, 12/07/21
- FID 2025, COD 2027

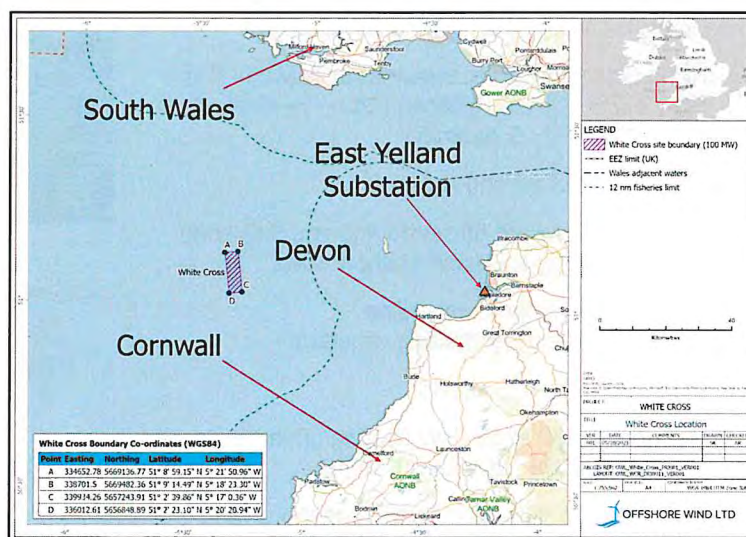
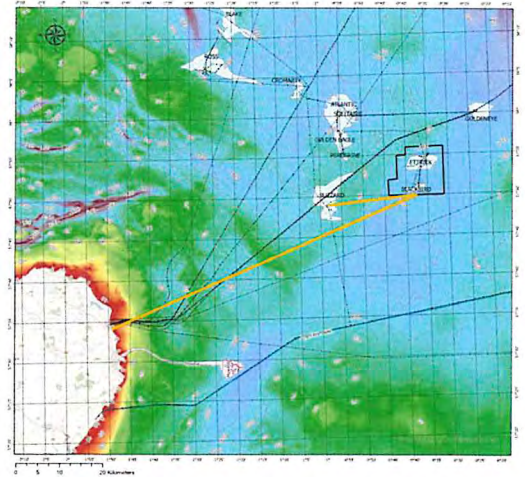
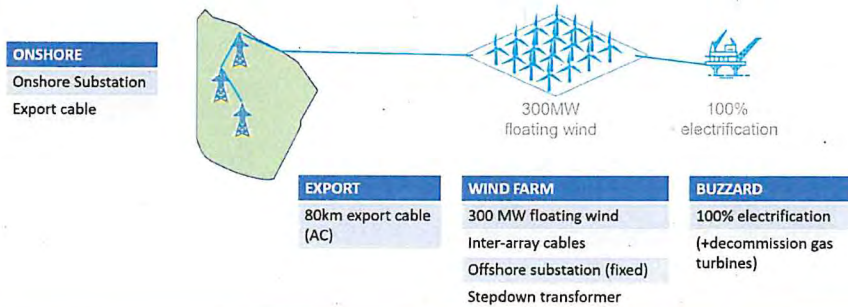


Figure 1: Map of White Cross Site

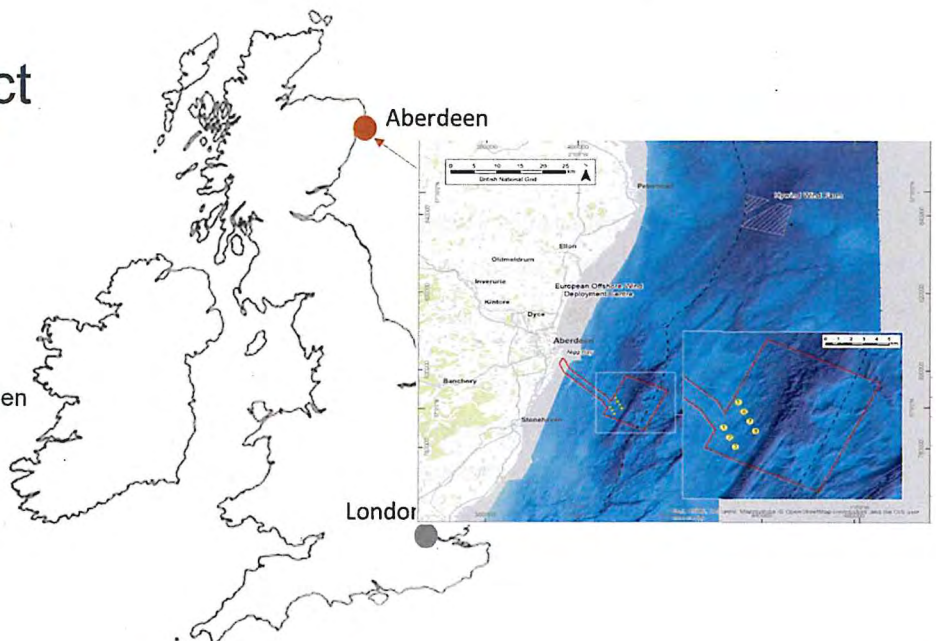
# Green Volt overview

- 300-500MW wind farm to power Buzzard - one of the UK's largest oil and gas fields
- 100% removal of current gas power generation
- Mitigation of 600,000 tonnes CO2/year emissions from 2027, equating to ~90,000 homes
- Maintains UK global leadership in offshore wind and floating wind



## Kincardine Project Case study: Background

- Maximum Output 50 MW
- 15 km east of Aberdeenshire coast
- Water depths 60m to 80m
- Turbines 5 x 9.5 MW Vestas V164
- Grid connection at Redmoss, Aberdeen
- Operational life of 25 years
- First Generation summer 2018
  - 1 x 2 MW Vestas V80
- Project Completion 2021



# Kincardine Project

## Semi-submersible structure

- Designed by Principle Power Inc
- Fabricated in steel
- Triangular semi-submersible structure
- Tower over one buoyancy chamber
- 3 mooring lines
- Installation of turbine in port
- Tow and operation in semi-submersible mode
- Maximum dimensions:
  - Tip height up to 191 m
  - Rotor diameter 164 m



# Kincardine Project

## Case study: Looking to the future

- Potential to use site to test additional floating technology
- New substructure solutions: semi-submersible/TLP etc.
- Novel installation/exchange techniques for wind turbines on floating structures
- Hydrogen generation from offshore wind
- Offshore environmental monitoring technology
- Compiling world's largest offshore bird data set
- Testing novel access systems in floating environment
- Application of lidar technology to optimise output



# Kincardine Project

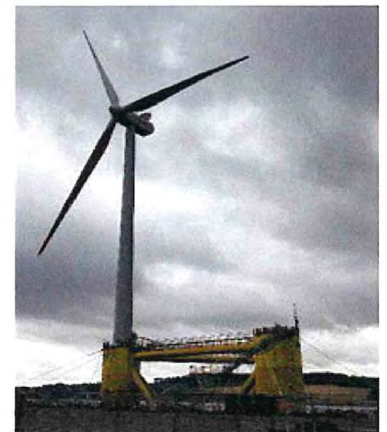
## Case Study: Lessons learned

- Substructures must be designed to be stable at shallower depths in harbour/nearshore conditions
- Modular design of substructure
- Modules built in smaller yards
- Transported to assembly yard
- Substructure assembly/Turbine installation close to site:
  - Max. 100 to 300 km from project site
- Improve offshore installation
  - Max. 48 hours from leaving port to securing machine at site



# Kincardine Project

## Turbine assembly



# Kincardine Project

Leaving Dundee 2018



# Kincardine Project

Preparing for and under tow 2018





# Kincardine Project

## Mooring installation 2018



# Kincardine Project

## Cable Lay 2018



# Kincardine Project

Fabrication of structures 2019/20



# Kincardine Project

Substructures awaiting and during transportation



## Primary Contacts



**Lord Nicol Stephen (UK)**  
Chief Executive Officer & Co-founder  
+ 44 7824 461 012  
nicolstephen@flotationenergy.com



**Tim Sawyer (Australia)**  
Chief International Officer & Director  
+61 488 400 811  
timsawyer@flotationenergy.com



**Allan MacAskill (UK)**  
Technical Director & Co-founder  
+ 44 7712 864 013  
allanmacaskill@flotationenergy.com



**Reggie Wu**  
General Manager, Taiwan  
+886 905 787 909  
reggiwu@flotationenergy.com

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# SULMARA





# sulmara

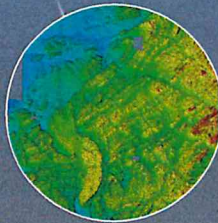
## SUBSEA

Kevin McBarron, Founder & CEO

13 Sep 2022

# Sulmara Services + Offshore Wind ▶

At Sulmara our goal is to provide an innovative approach to offshore survey services with a focus on driving efficiency through adoption of new technology and methodology to hasten the move towards a net zero carbon future.



### Site Investigation

- EIA
- Metocean
- Geophysical
- Geotechnical
- UXO



### Construction

- Pre-Installation
- Installation
- Monitoring
- Trenching
- Post-Installation
- Metocean



### O&M

- Cable Survey
- Seabed Survey
- Sand-Wave Migration Survey
- Asset Inspection
- Metocean

Fixed & Floating Wind Farm Developments



# Sulmara + Taiwan

We have incorporated Sulmara Renewables Ltd(樹木旺再生能源有限公司) in Taiwan to provide services on the ground in support of our projects, including USV operations.

Mimi Leung leads the growth of Sulmara's business in Taiwan.



## 7 Projects in Taiwan ▶

- ▶ 01 Orsted @ Greater Changhua(大彰化東南)
- ▶ 02 Orsted @ Wo Neng(沃能1、2號)
- ▶ 03 Orsted @ Xu Feng(旭風2、3號)
- ▶ 04 COP @ CFXD(彰芳暨西島)
- ▶ 05 Formosa-3(海鼎)
- ▶ 06 Seaway 7 @ CFXD(彰芳暨西島)
- ▶ 07 Jan De Nul @ Formosa 2(海能)
- ▶ 08 Seaway 7 @ Yunlin(允能)





# Sulmara + IRP Implementation

- ▶ DFO (東方風能) Maritime Partner
- ▶ Lian Tat (聯達行) Marine Engineering Partner



# Sulmara + LOCAL talent

Sulmara are dedicated to contributing to the development of local talent and do this by forging links with academic institutions and local service providers.

- ▶ NTU (台灣大學) Internship program
- ▶ IONTU (台灣大學海研所) EIA Technical Collaboration



# Sulmara + Innovation ▶

- ▶ Reduces HSE risk  
(減少人員暴露海上之危險因子)
- ▶ Low noise radiation  
(降低噪音對海洋生物及環境之危害)
- ▶ Low fuel consumption & carbon footprint  
(減少碳足跡實踐企業綠色承諾)
- ▶ High weather capability  
(抗浪性高於一般船隻·有效延長天氣窗口)
- ▶ Improved survey data quality  
(搭載高解析度探測聲納獲取高品質資料)



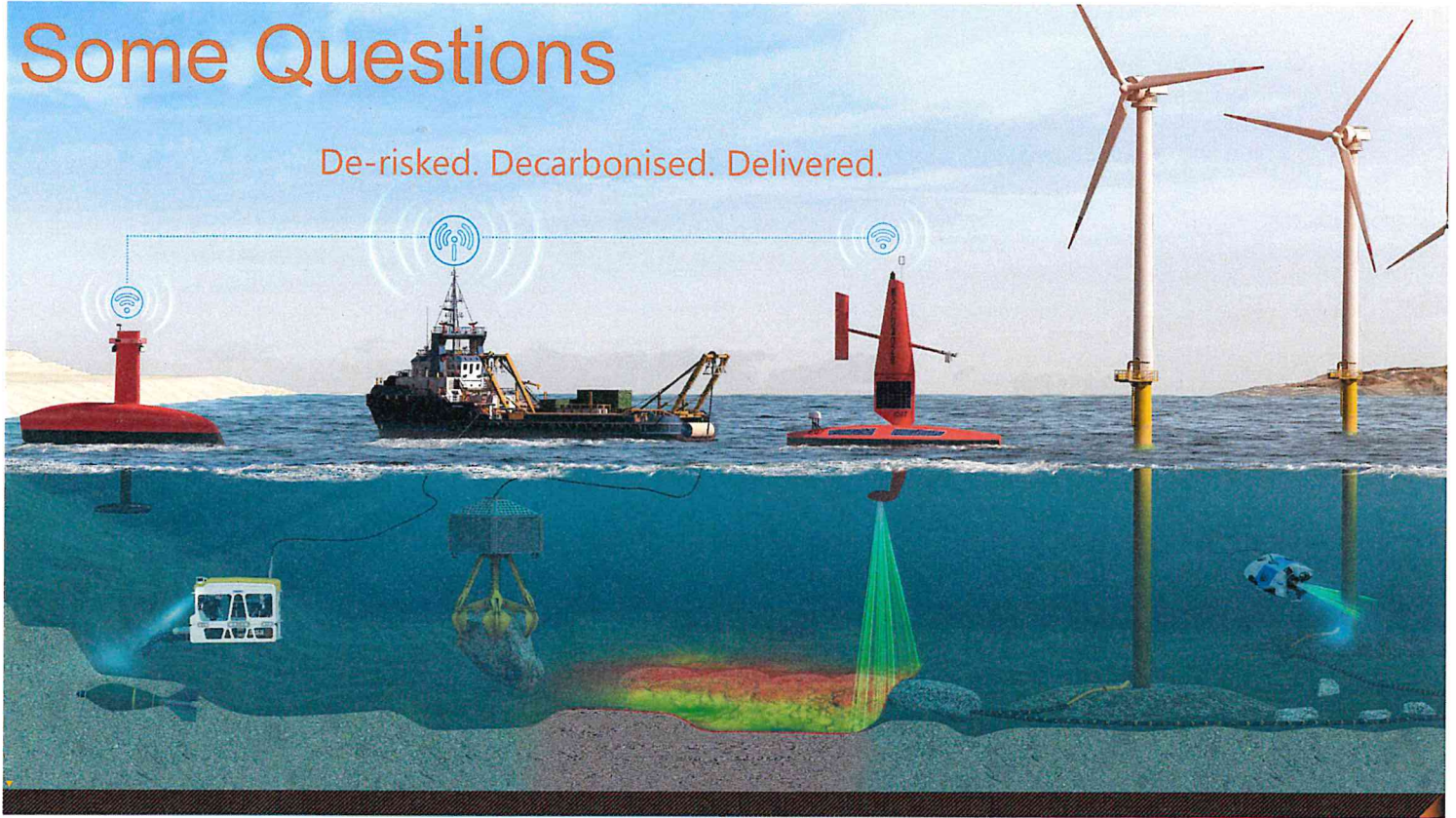
# Sulmara + Floating Wind ▶

- ▶ Use of USV for early site characterization  
(UK, California & S Korea)
- ▶ Involvement with leading Floating Wind consultancy OSG(Offshore Solutions Group) in UK
- ▶ Case studies for more efficient delivery of floating wind for Operators:
  - Survey by USV of wet storage locations for turbines & moorings off UK coast



# Some Questions

De-risked. Decarbonised. Delivered.



## Thank-You

Come and visit us in UK  
Pavilion, Energy Taiwan 2022

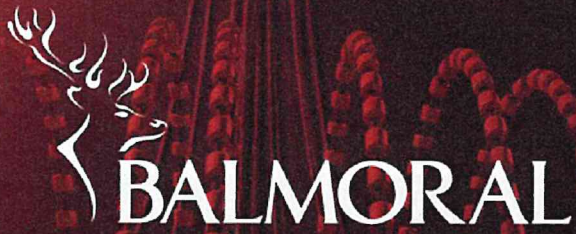
 **ENERGY  
TAIWAN**  
台灣國際智慧能源週

2022年10月19-21日  
台北南港展覽館一館

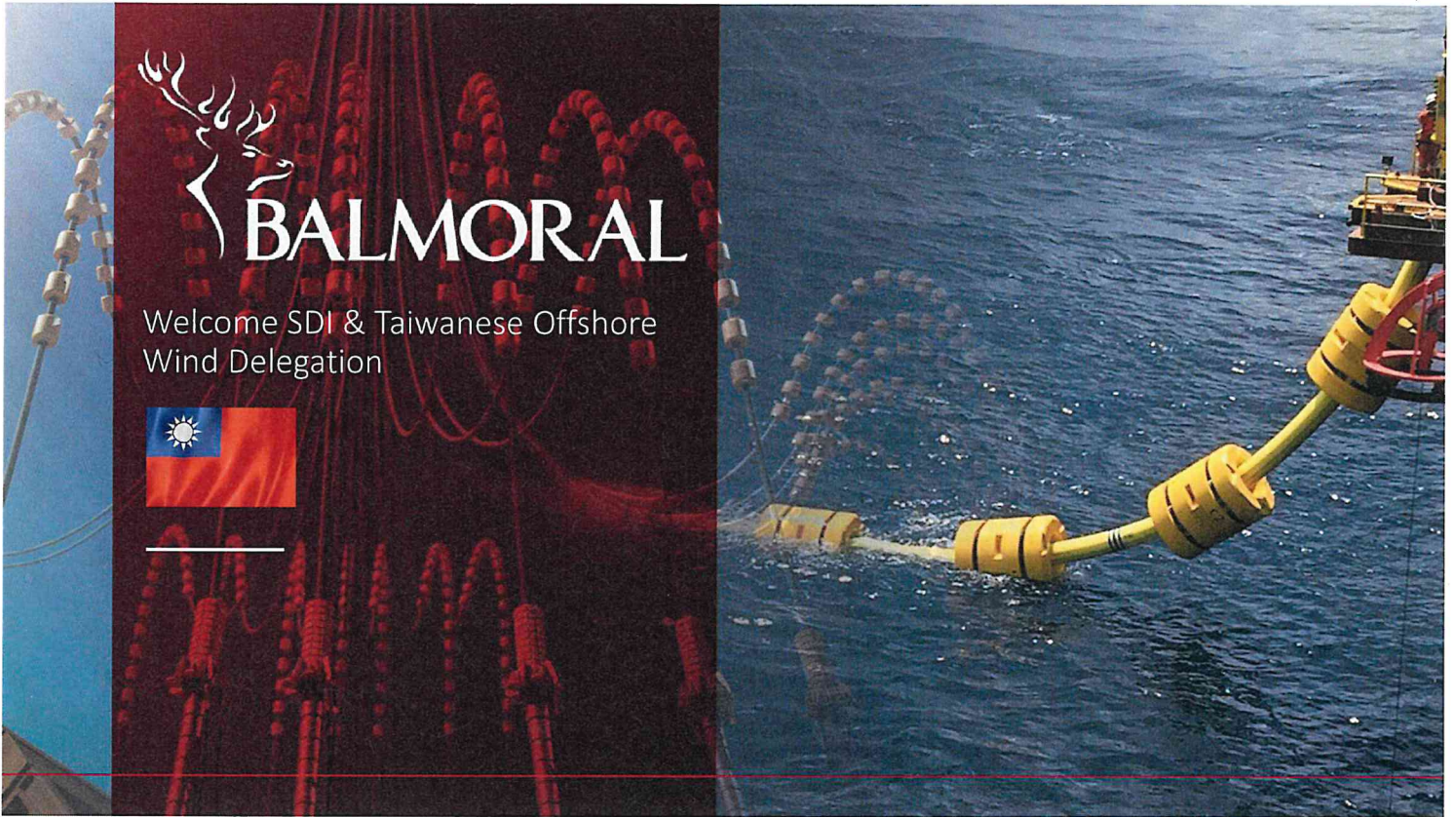


# BALMORAL





Welcome SDI & Taiwanese Offshore  
Wind Delegation



## Balmoral Group



### Privately owned company

Autonomous divisions:  
*Balmoral Comtec*  
*Balmoral Tanks*  
*Balmoral Park*  
*BLAZE Manufacturing Solutions*



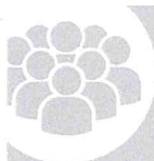
### Solutions provider

A global manufacturing partner  
offering unrivalled technical  
expertise and evidence-based  
product solutions helping  
customers advance in their markets



### Headquarters in Aberdeen

Supported by international  
operations network



### Employs over 650 staff

# Balmoral Group HQ and Balmoral Comtec

250,000 sq ft manufacturing facility, Aberdeen



## Balmoral

Buoyancy, insulation and protection solutions



**A solutions provider**  
to the global energy, defence and oceanographic sectors



**Products operating to depths of 7000m**



**40+ year Evidence-based track record**  
With unrivalled technical experience



**'The Balmoral Discovery Unit'**  
state of the art R&D facilities



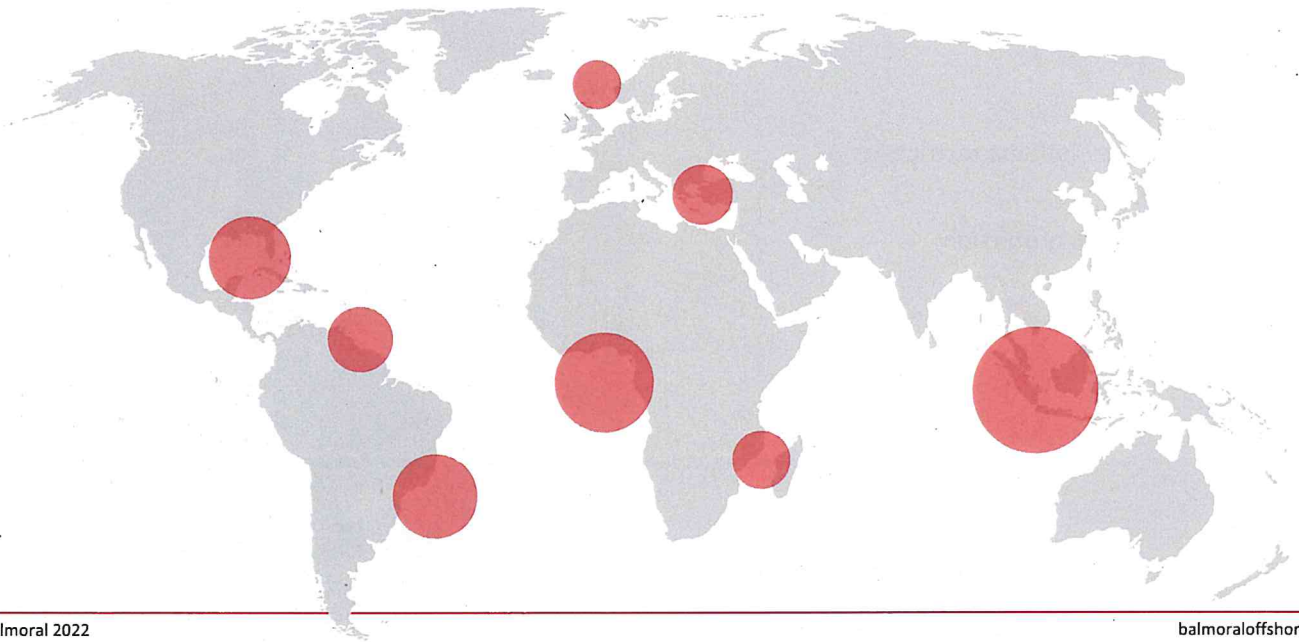
**Subsea test facilities to 700bar/7000msw**



**2 manufacturing locations**  
Aberdeen  
Newcastle



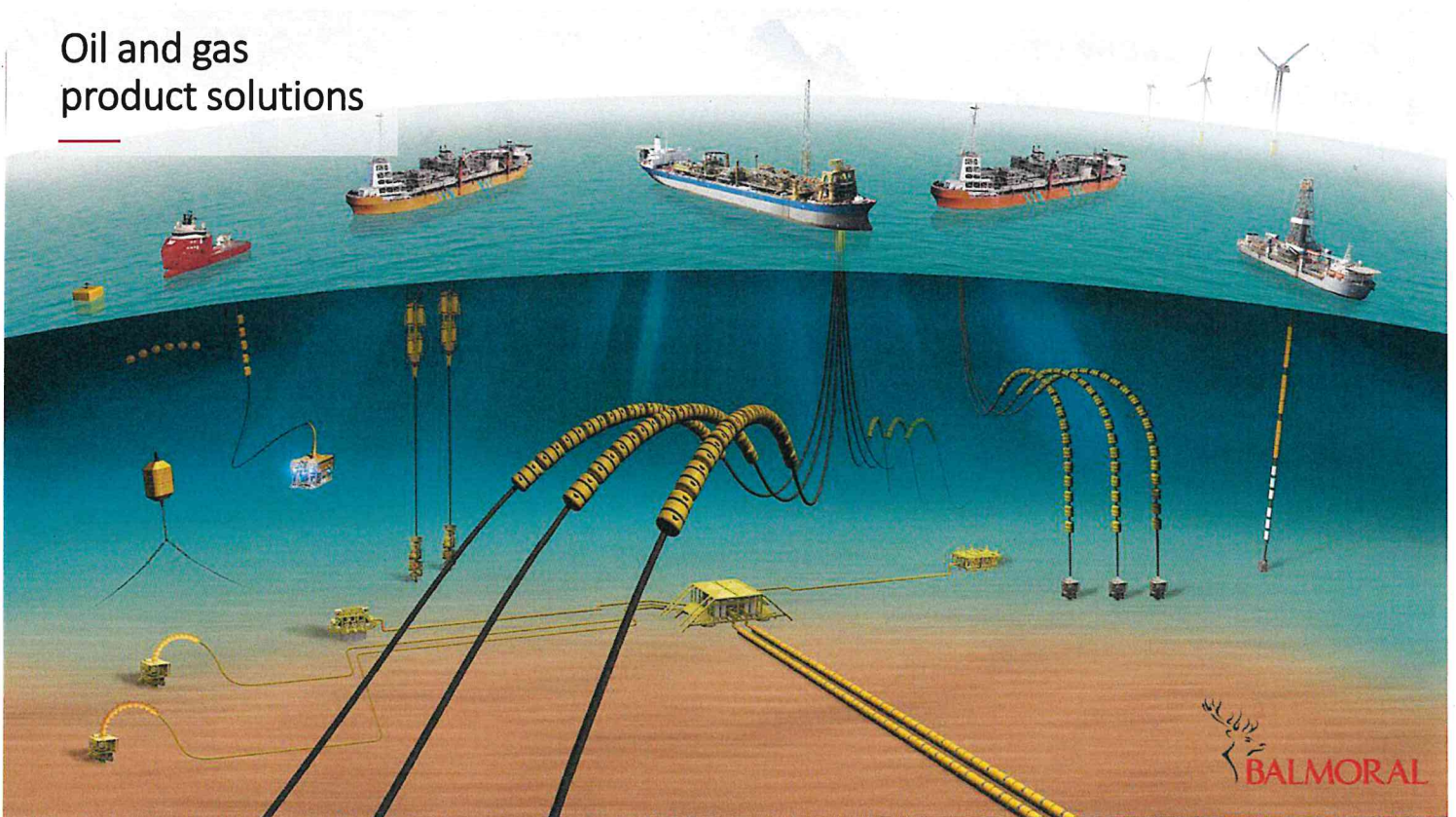
## Where Balmoral products are used



© Balmoral 2022

[balmoraloffshore.com](http://balmoraloffshore.com)

## Oil and gas product solutions



## Product solutions

### Subsea umbilical, risers and flowlines (SURF)

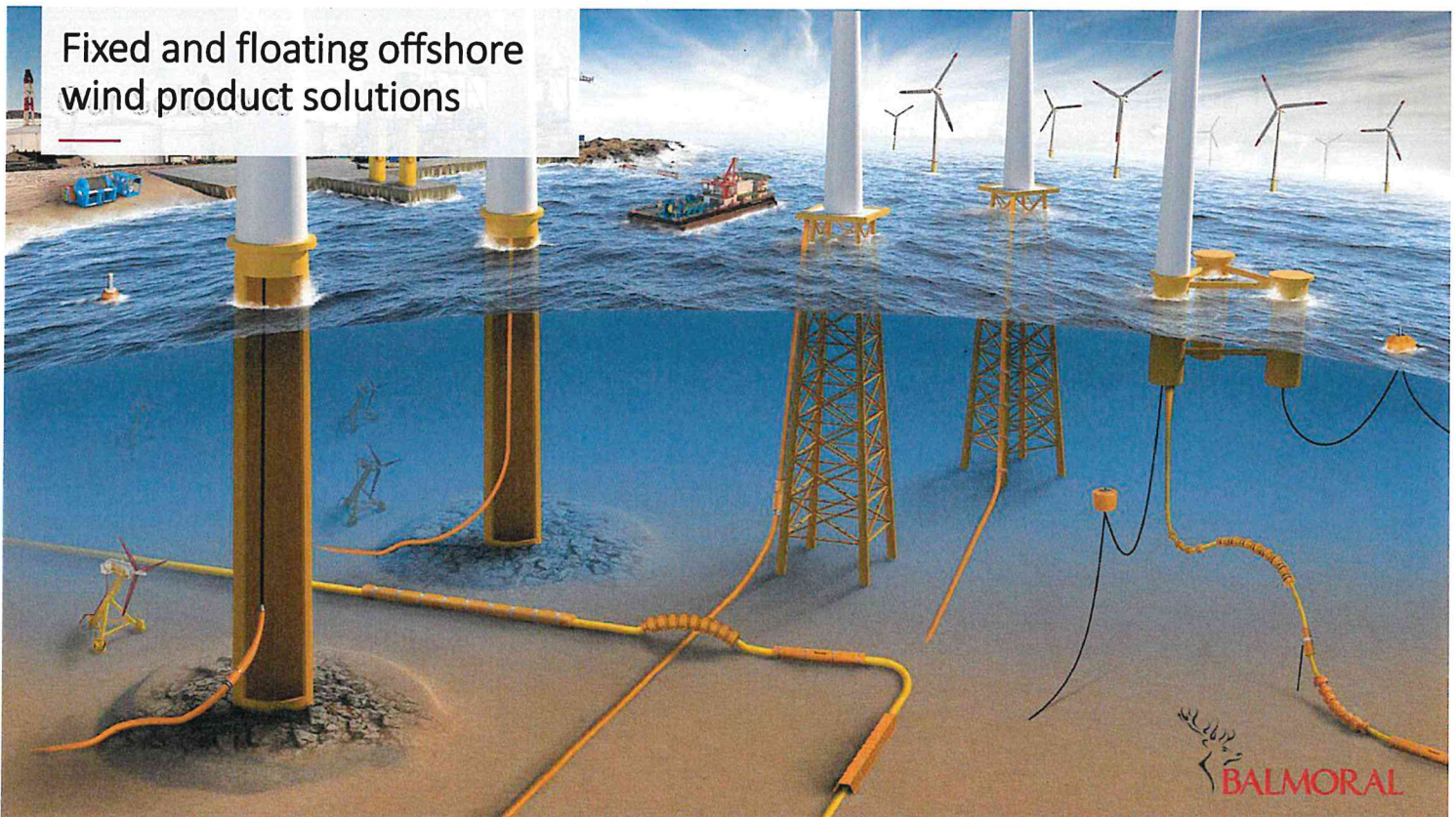
- Distributed buoyancy
- Bend restrictors / boltless restrictors
- Bend stiffeners
- Cable and pipeline protection



© Balmoral 2022

[balmoraloffshore.com](http://balmoraloffshore.com)

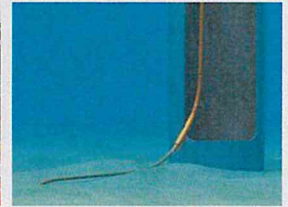
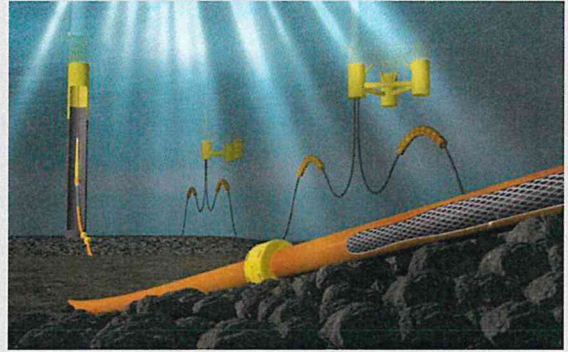
### Fixed and floating offshore wind product solutions



## Product solutions

### Fixed and floating offshore wind

- Patented cable protection system (CPS)
- Integrated stability system
- Bend stiffeners and restrictors
- Flexible J-tubes
- Floating offshore wind integrated solutions
- Retrofit J-tubes
- Pre-terminated cable covers
- In-house test rig



## Product solutions

### Marine / construction

- Surface / subsurface buoyancy
- Modular subsurface buoyancy
- Ultra-low density syntactic foams
- ROV/AUV buoyancy



## Balmoral Subsea Test Centre

The industry's most comprehensive, accessible and commercially available hydrostatic and mechanical testing facility for the subsea, renewables, defence and oceanographic sectors.

- Hydrostatic testing
- Mechanical testing
- Submersion test tanks
- Development and test laboratories

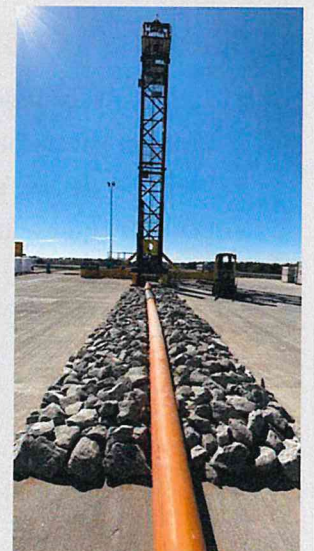
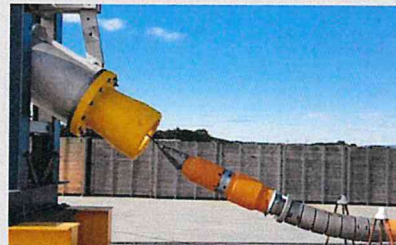


© Balmoral 2022

[balmoraloffshore.com](http://balmoraloffshore.com)

## Balmoral CPS Testing Tower

- Each component factory acceptance tested
- Replicating system pull-in for WTG or Jacket
- Varying cable size and configurations accommodated
- Multiple angle, height and load installations
- All data captured and logged
- Training for personnel on system assembly



© Balmoral 2022

[balmoraloffshore.com](http://balmoraloffshore.com)

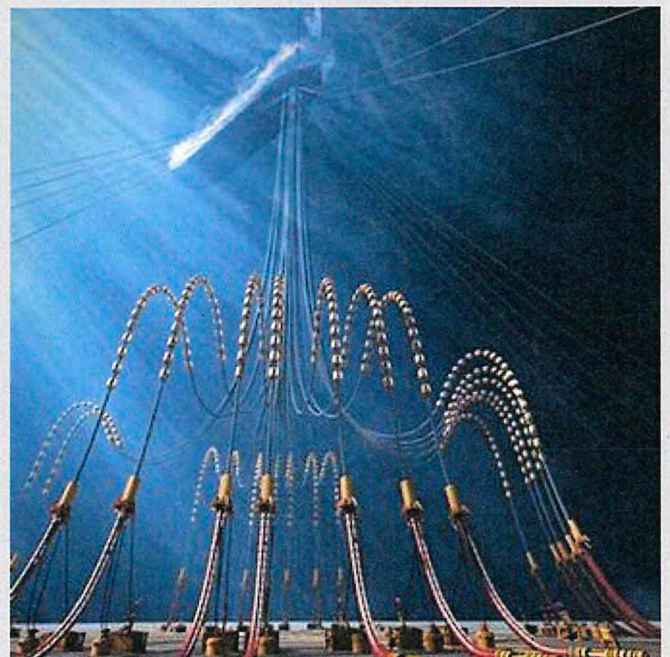
## Benefits of working with Balmoral

- **Market leading track record** for distributed buoyancy across the world, vast experience of ultra deep-water projects
- **Large production capacity** – mould manufacture, clamp manufacture, rotational moulding, macrosphere production, foam systems etc
- **High levels of vertical integration** - Total control throughout the design, manufacturing and production process – allows us to guarantee quality and accurately predict schedule and delivery



## Benefits of working with Balmoral

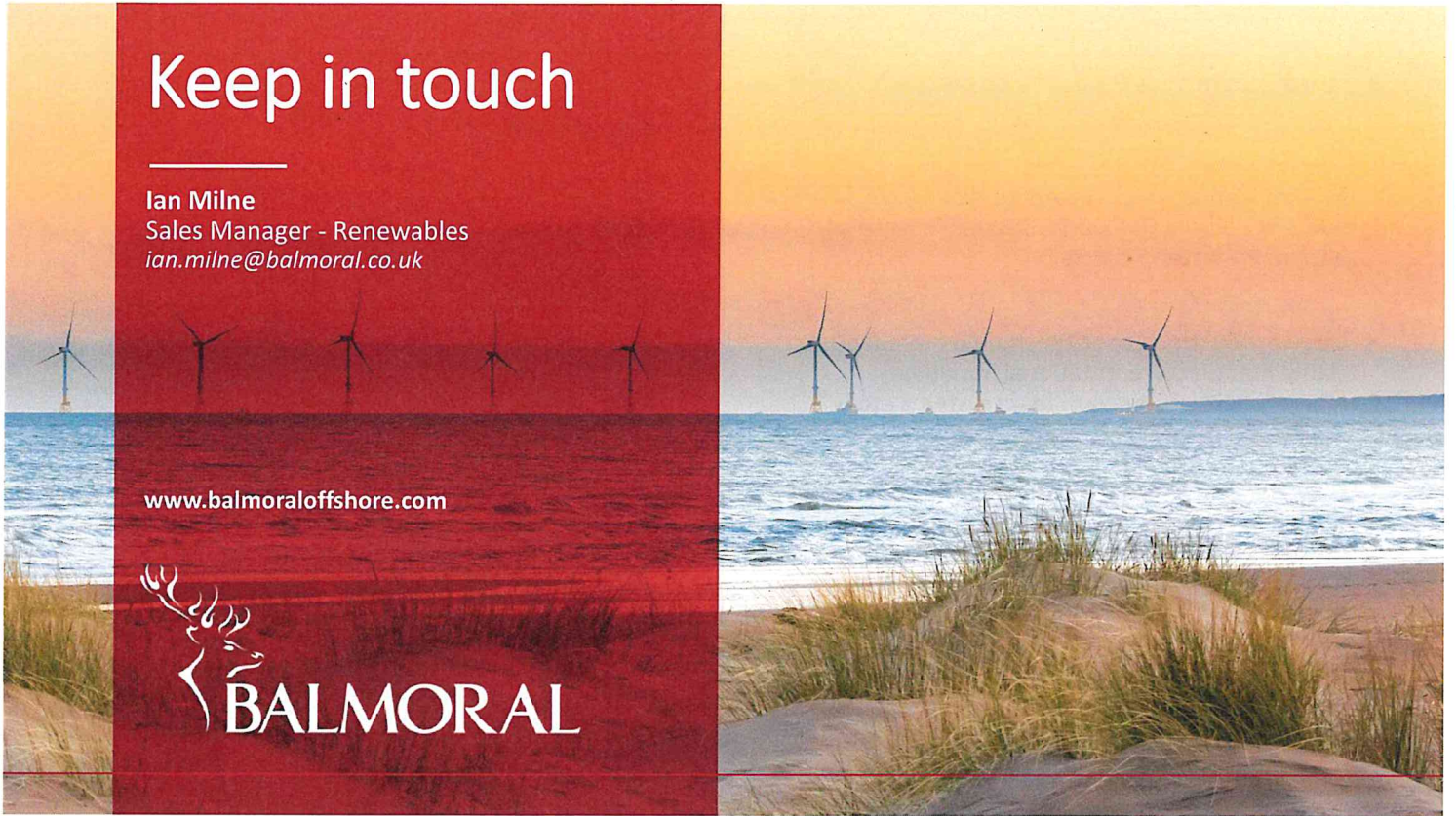
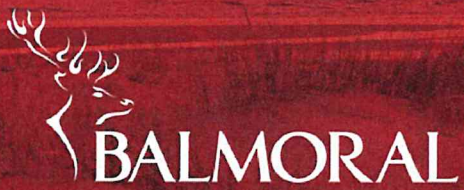
- **Extensive in-house design and engineering capability** – guaranteeing our clients the highest possible standards of engineering support and input
- **Market leading R&D and testing facility**
- **API 17L certification** – potential for reduced documentation, testing
- **Vast and unrivalled track record** for DBMs globally
- **Strong track record** for bend restrictors and bend stiffeners



# Keep in touch

Ian Milne  
Sales Manager - Renewables  
[ian.milne@balmoral.co.uk](mailto:ian.milne@balmoral.co.uk)

[www.balmoraloffshore.com](http://www.balmoraloffshore.com)



# ROVOP





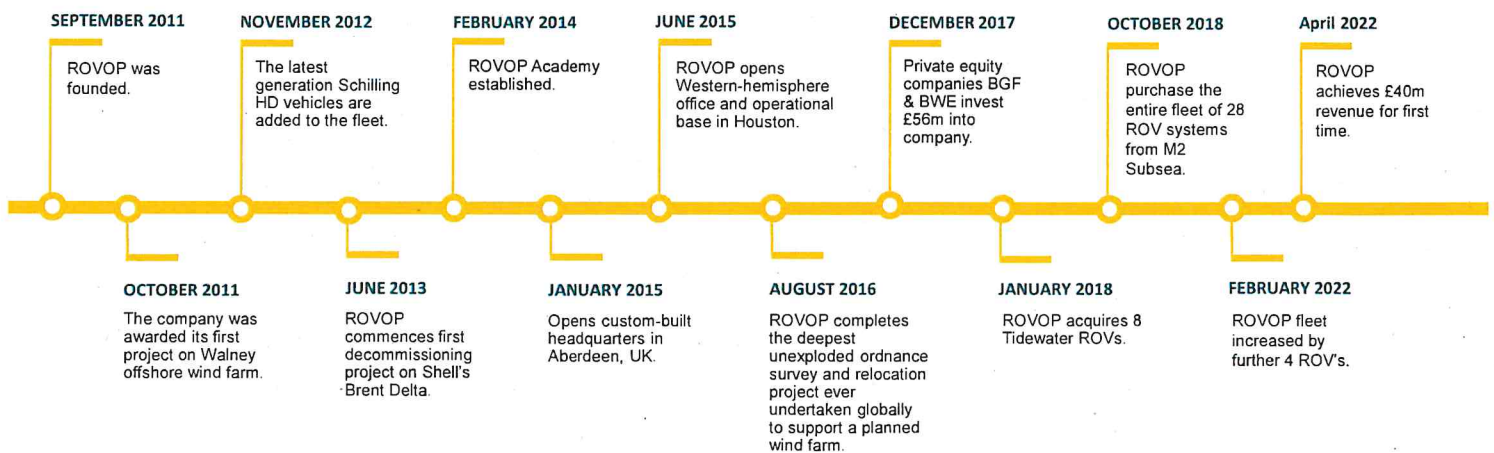
# AN INTRODUCTION TO ROVOP

SEPTEMBER 2022

# ROVOP



## ROVOP - OUR EVOLUTION



ROVOP

# KNOWLEDGE IN DEPTH



INDEPENDENT ROV SPECIALIST



247 STAFF



45 ROV SYSTEMS



98.98% UPTIME



PRIVATE EQUITY BACKED

**ROVOP** 10+ YEARS INDUSTRY EXPERIENCE

## GLOBAL REACH – LOCAL PRESENCE



HYDROCARBON,  
OFFSHORE WIND,  
POWER & TELECOM  
INDUSTRIES

**ROVOP**

# GLOBAL REACH – LOCAL PRESENCE

- ✓ Global ROV availability
- ✓ Global ROV personnel availability
- ✓ Assets strategically placed in key regions
- ✓ Onshore **24/7 technical support** with dedicated Schilling, Triton, SAAB and Sub Atlantic technicians
- ✓ Inhouse tooling and sensor support
- ✓ In house manipulator repair and maintenance



● ROVOP Infrastructure  
● Operations/Track Record

**ROVOP**

# WIDE RANGING FLEET TO SERVICE MULTIPLE MARKETS

## ELECTRIC INSPECTION AND LIGHT WORK-CLASS FLEET

TIGER



1

LYNX



1

MOHICAN



3

COUGAR XT PANTHER XT PLUS



2



4

COMANCHE



2

## HYDRAULIC WORK-CLASS FLEET

SCHILLING HD



17

TRITON XLS



3

TRITON XLX



8

SCHILLING UHD Gen III



4

## ROVOP

## OUR OPERATIONS

### Europe and Africa



Leonardo Da Vinci



Normand Pacific



EDT Hercules



Boka Topaz



NKT Victoria



McDermott Amazon



Boka Polaris



Boka Atlantis

### Asia Pacific



Giulio Verne



NO105



NO108



Onyx



DLV 2000

### Middle East



DB50



DB32



Boka Da Vinci



MMA Pinnacle

## ROVOP

### Gulf of Mexico



Hydra Responder IV



Frída I



Solitaire

## A SELECTION OF OUR CLIENTS

**MCDERMOTT**

**VALARIS**

**Prysmian**

Petrofac 

**NKT**

**DJN Jan De Nul**  
GROUP

 **TotalEnergies**

bp  


**subsea 7**

**EDT**  
Offshore

 **Boskalis**

 **Harbour**  
Energy

**ROVOP**

**ROVOP IN TAIWAN**

**ROVOP**



ROVOP provides 2 x WROV in the Taiwanese market currently

## ROVOP in Taiwan

- Vessel –
  - Onyx
- Projects –
  - Changfang & Xidao
  - Yunlin
- Client
  - Seaway 7
- Support –
  - Port calls/crew changes - Taichung
  - Project managed Singapore
  - Local agent - Benline
  - Consumables etc purchased locally
- Challenges
  - Quarantine
  - Contracting
  - Environment - Current



ROVOP

# INVESTMENT IN PEOPLE

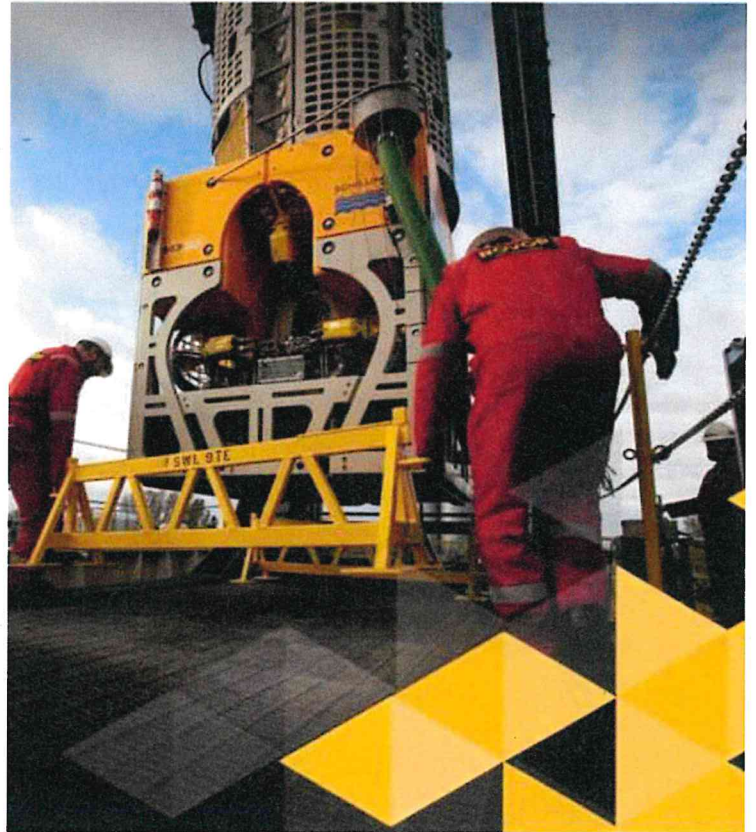
ROVOP

## ROV PERSONNEL

With ROV operations on a global basis, across different types of ROV systems in different subsea segments, ROVOP has developed a specialized capability in the ROV personnel marketplace.

- Highly skilled internal staff pool
  - ✓ IRM experience
  - ✓ Construction experience
  - ✓ Offshore wind experience
  - ✓ Decommissioning experience
- Agnostic vehicle capability
  - ✓ Schilling
  - ✓ Saab
  - ✓ Triton
- Individual country ROV personnel market knowledge
- Market leading knowledge of contractor personnel market

## ROVOP



# CASE STUDIES

ROVOP

## SECTOR

### Cross energy markets

## PROJECT

### Major provision of ROV Services to Tier 1 installation contractor

## WHAT WE DELIVER

Global MSA covering ;

- ✓ ROV services
- ✓ Dedicated project management
- ✓ ROV Personnel
- ✓ Intervention tooling

In 2017, ROVOP were awarded a wide ranging global MSA to provide ROV services across the vessel fleet of a Tier 1 installation contractor in the oil and gas and renewables sectors.

This has seen ROVOP provide more than 15 ROV installations over the period, across a range of differing types of vessel, carrying out different types of ROV work ;

- ✓ Construction vessels
- ✓ Lay barges
- ✓ Heavy-lift
- ✓ Pipe-layers

## HIGHLIGHTS

- ✓ 15+ ROV's deployed over life of contract, single and dual installations
- ✓ 99.24% uptime across ROV deployments YTD
- ✓ 25,000 hours of dive time in last 2.5 years



## ROVOP

## SECTOR

### Offshore wind

## PROJECT

### Major European offshore wind installation campaign for a Tier 1 contractor

## WHAT WE DELIVERED

ROV support to allow successful installation of 42 wind turbine foundations and one substation foundation. The ROV also assisted with installing 78 messenger wires, including the associated plugs and earthing clamps of each foundation.

ROVOP developed a full working procedure and carried out an onshore System Integration Test (SIT) to prove the methodology.

Before mobilisation, ROVOP worked closely with specialist equipment providers and the end client, utilising our dedicated SIT vehicle to confirm the compatibility of the torque tools and implement changes. Our offshore staff were present, promoting a seamless understanding of the project ahead of mobilising.

## CHALLENGES

- ✓ New Work Scope for Client
- ✓ High Currents
- ✓ Poor Visibility
- ✓ Demanding Schedule



## ROVOP

## SECTOR

Oil & gas

## PROJECT

Platform-Based IRM scope for a UK operator.

### WHAT WE DELIVERED

Successful **remote** anchor chain inspection, cleaning and measurement with an additional deliverable of subsea template modelling (3D point cloud produced using photogrammetry).

Using the latest communications and modelling technology, ROVOP worked closely with the client to develop a robust live video streaming service back to shore. Two-way open communications allowed the inspection and data recording engineers to run the work scope remotely from onshore, resulting in three less people on board the vessel, where accommodation was limited due to the COVID-imposed restrictions.

The cloud-based viewing platform allowed those working from home to view the inspection work as it unfolded. They were able to see exactly what the ROV and inspection engineers were seeing in real-time. Data, which would once have taken weeks to return from offshore to be analysed, was captured as those watching onshore were able to influence the operation live, making the campaign much more efficient.

### CHALLENGES

- ✓ Limited bed space on the platform due to Covid restrictions
- ✓ Congested worksite subsea
- ✓ Technical challenge to live stream data onshore for the inspection team



## ROVOP

# THANK YOU

## ROVOP

KNOWLEDGE IN DEPTH



ABL





The Energy & Marine Consultants.

## Taiwan-UK Renewable Energy Round Table Mission

Introduction to ABL Group

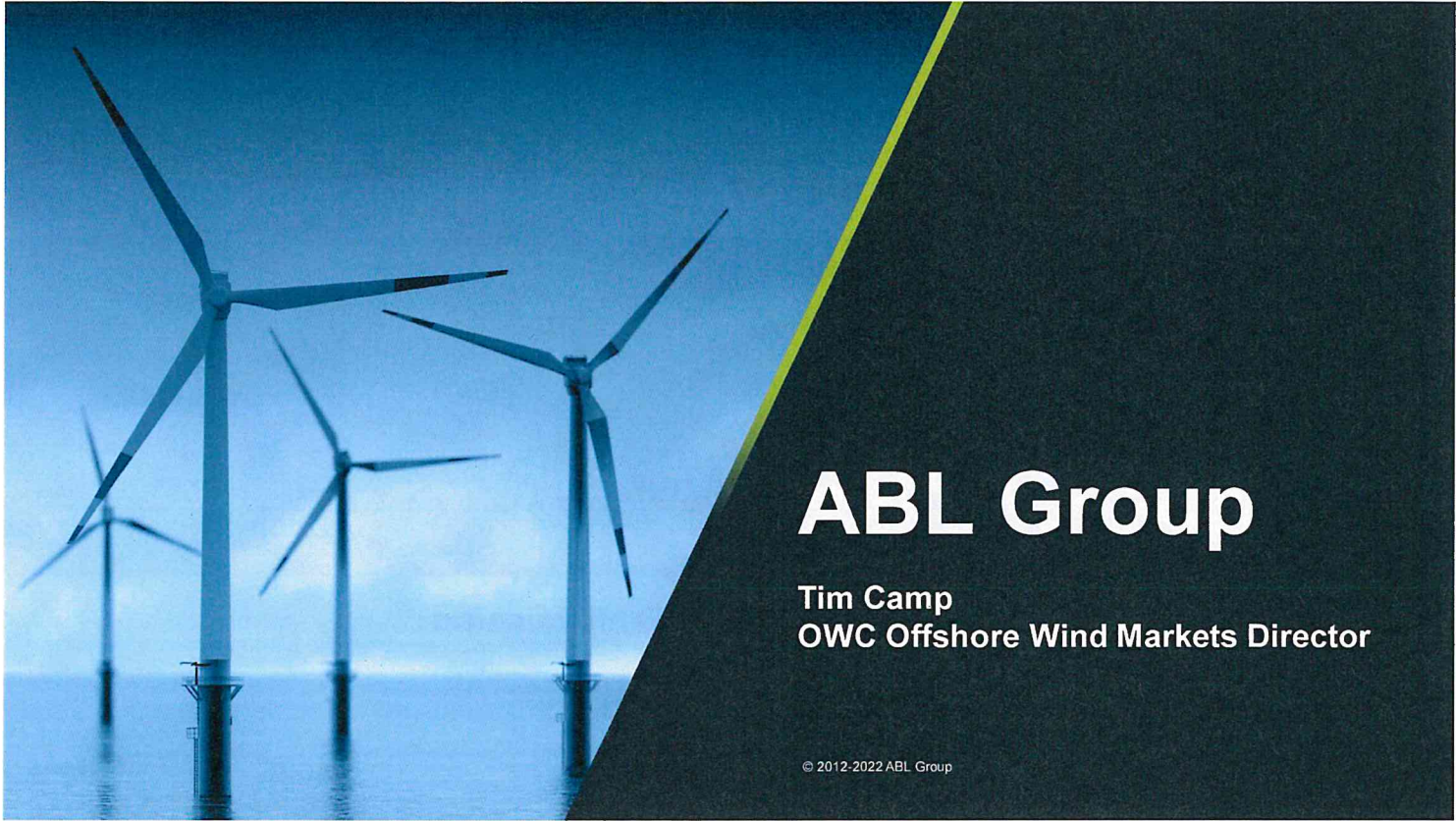
15<sup>th</sup> September 2022

[abl-group.com](http://abl-group.com)

## Agenda

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- Welcome & introduction to ABL Group  
*Tim Camp – OWC Director of Offshore Wind Markets*
- Offshore Wind Consultants  
*Zheming Li – OWC UK Country Manager*
- Port requirements to support offshore wind  
*Wei-Yang Tan – Civil Engineer & Ports Specialist*
- Marine Warranty, Transport & Installation services  
*Mike McLachlan – Renewables Projects Director*
- Discussion



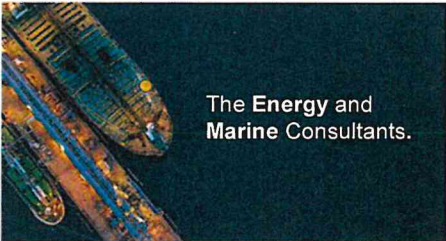
# ABL Group

**Tim Camp**  
**OWC Offshore Wind Markets Director**

© 2012-2022 ABL Group

## ABL Group

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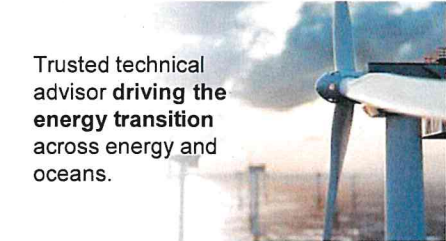
**The Energy and Marine Consultants.**



**Deepest pool of world-class expertise across marine and engineering disciplines.**



**Your global partner, local expert:**  
62 offices; 38 locations.



**Trusted technical advisor driving the energy transition across energy and oceans.**



**Broader service offering, providing all-round support, no matter the locations, size or type of project.**



**Portfolio of services covering consultancy and engineering, loss prevention and loss management.**

## Our Service Portfolio



### CONSULTING & ENGINEERING

- Technical due diligence
- Owner's engineering & construction monitoring
- Geotechnical & geophysical
- HSEQ & risk
- Marine operations
- Marine design, upgrade & conversion
- Site investigations
- Clean shipping
- Engineering & design
- Jack-up & wind farm installation vessels
- Advance analysis & simulation
- Digital services
- Cable engineering
- Marine consulting
- Client Reps & secondments



### LOSS PREVENTION

- Marine surveys, inspections & audits**
  - Vessel and marine assurance
  - Rig inspections and assurance
  - Industrial standard audit
  - Vessel condition survey
  - Pre-purchase survey
- Marine warranty survey**
  - Renewables
  - Oil & gas
  - Operations
  - Project cargo
  - Rig moving
  - Decommissioning



### LOSS MANAGEMENT

- Marine casualty support & management**
  - Salvage & wreck removal
  - Hull & machinery (H&M) claims
  - P&I claims
- Expert witness & litigation**
  - Energy expert witness & litigation
  - Marine expert witness & litigations
  - Marine casualty investigations

5



## Global Partner, Local Expert



62

Offices



38

Countries



303\*\*

Locations – including Taipei



1100\*

People – including 20 staff in Taiwan



6

\* Includes subcontractors on 100% utilisation basis. Calculated as an average during Q4 2021.

\*\* ABL locate many staff strategically at maritime and offshore hubs to be able to serve clients locally

Additional note: the 39 countries number is driven by our offices, in terms of locations where we have surveyors etc we cover 71 countries, a truly global footprint



# The ABL Group Family



**ABL Group**  
 ABL Group is a leading global independent energy and marine consultancy working in energy and oceans to de-risk and drive the energy transition across renewables, maritime and oil and gas sectors.



**OWC**  
 An ABL Group Company  
 OWC  
 Project development services, owner's engineering and technical due diligence to the offshore renewables industry.



**EAST POINT GEO**  
 An ABL Group Company  
 East Point Geo  
 Expert Geoconsulting organization supporting all sectors; providing efficient client-focused deliverables including data assurance, ground models and quantitative risk assessment.



**LONGITUDE**  
 An ABL Group Company  
 Longitude Engineering  
 Independent engineering, design and analysis services for the marine, renewables, oil and gas, defence and offshore infrastructure industries.



**JLA**  
 An ABL Group Company  
 John LeBourhis & Associates (JLA)  
 Rig moving, risk control services and surveying services  
 Specialists in MODUS



**INNOSEA**  
 An ABL Group Company  
 INNOSEA  
 Engineering advisory, verification, research and development, concept development and consultancy for marine renewable energy.



**OSD-IMT**  
 Part of Longitude  
 OSD-IMT  
 Established in 1989, a specialist ship design house focused on offshore support vessels and clean shipping technology.



**ABL YACHTS**  
 An ABL Group Company  
 ABL Yachts  
 Superyacht surveyors and consultants.

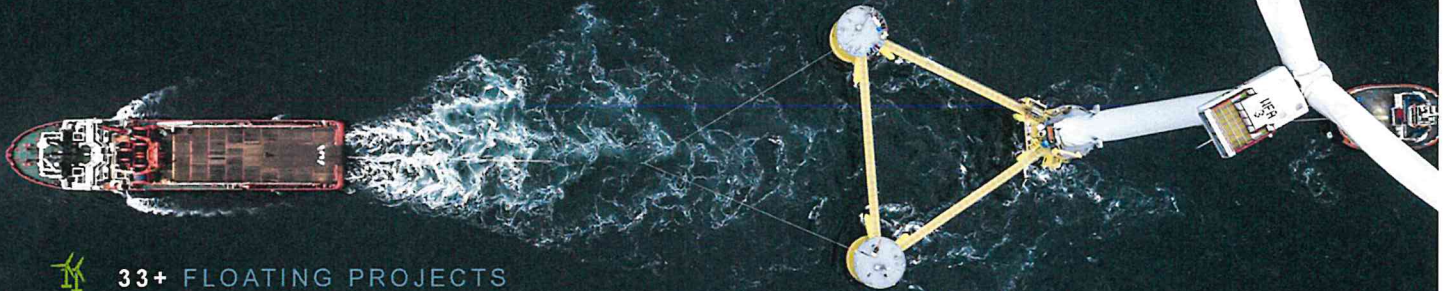






## Some Of Our Customers

Renewables	Maritime & Energy Underwriters / brokers	Oil and Gas



## ABL Group Offshore Wind Experience\*



-  33+ FLOATING PROJECTS
-  13+ GW FLOATING CAPACITY
-  260+ OFFSHORE WIND PROJECTS
-  150+ GW TOTAL OFFSHORE WIND CAPACITY

\* End Q4 2021



## Offshore Wind Consultants

Zheming Li  
OWC UK Country Manager

© 2012-2022 ABL Group



## Introduction

Long standing experience of developing and realising projects.

- The **Offshore Wind Consultants**.
- **Established in 2011** by a team of experts who had been involved in offshore wind farm construction **since 1990s**
- **Global specialist** offshore wind consultancy with a **local presence**

Providing **project development services, owner's engineering and technical due diligence**, OWC are the only global consultancy dedicated to offshore wind.

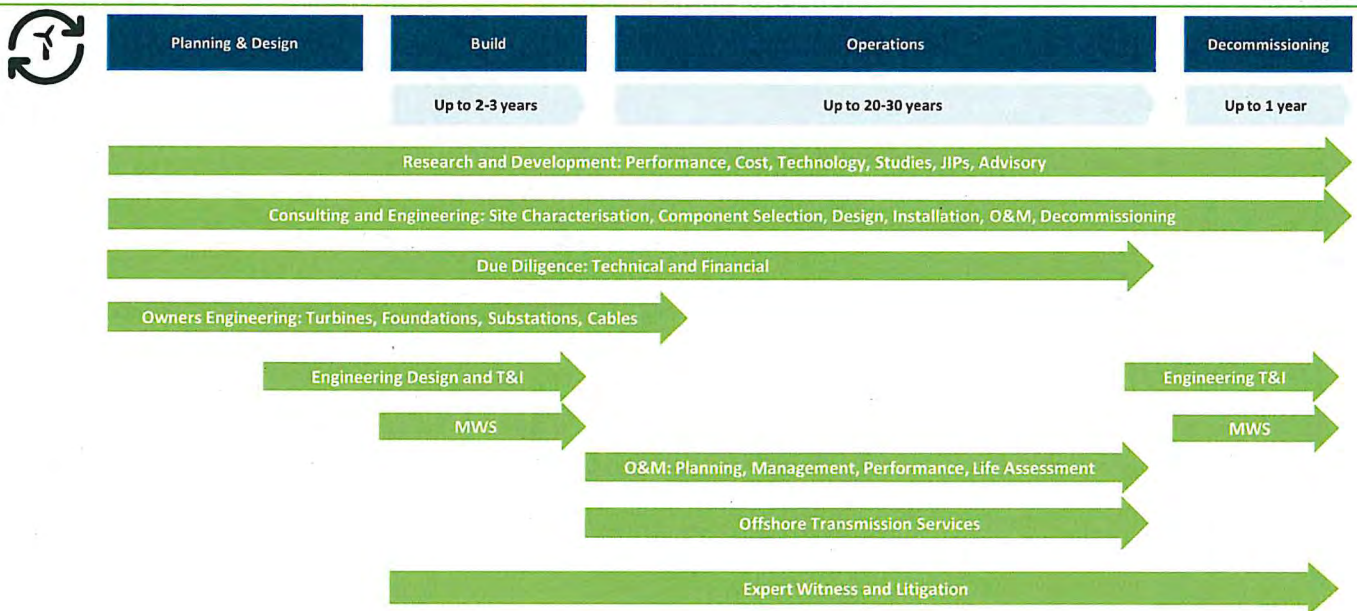
- **>70 projects (>50GW) since 2011**
- **>100 offshore wind experts** in 11 countries
- Dedicated OWC teams in **London, Edinburgh, Cork, Hamburg, Warsaw, Taipei, Tokyo, Vietnam, Busan, Seoul, Boston, New York and Rio de Janeiro**
- Active in floating wind since 2017 (Kincardine)

## Renewables segments covered



[owcltd.com](http://owcltd.com)

## Renewables Service Offerings





## Staff resources

- ABL Group: 1100 FTE
- OWC: 102 FTE

	Technical	Admin	Total
UK	46	15	61
Germany	9	1	10
Poland	4	0	4
Ireland	3	0	3
<b>Taiwan</b>	<b>9</b>	<b>2</b>	<b>11</b>
Korea	5	1	6
Japan	4	0	4
Vietnam	1	0	1
Greece	2	0	2
TOTAL	83	19	102

Taiwan office has a 20-people team including contractors

13



## OWC Taiwan 海上風諮詢有限公司



- Established in 2018
- 20 people team
- Experience in most projects
- Owner's Engineering
- Site Investigations
- Technical Due Diligence
- Bid Management
- Consultancy & Advisory
  - Risk & QAQC
  - T&I
  - Extreme weather
  - Site Selection
  - Localisation
  - EIA support



+ professionals with more than 10 years in FOW



Offshore Wind Consultants Taiwan Co., Ltd  
 海上風諮詢有限公司  
 6F-2, No. 432, Sec. 1, Keelung Rd., Xinyi Dist.,  
 Taipei City 11051  
 台北市信義區基隆路一段432號6樓之2

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Well established in Taiwan and collaborating with other Taiwanese entities



## OWC Taiwan 海上風諮詢有限公司. History



Established in 2018, OWC Taiwan follows a similar path with Taiwanese OW.

- Initial steps:
  - Initial majority of experts expats
  - Most of the team embedded F2
  - Significant part of technical works done abroad
- Now: more than 50% staff young Taiwanese members + supported by expert
- Future: Increase the team further and complete the range of services
  - Exploit Floating Offshore Wind Expertise
  - Exploit Supply Chain Development knowhow
  - Exploit Port & Infrastructure knowledge

OWC Taiwan can combine with Global support from sister companies



## OWC Taiwan 海上風諮詢有限公司. References



Some references:

No.	Capacity	WTG [MW]	MWS	Advice	Eng	TDD	O&M	No.	Capacity	WTG [MW]	Advice	Eng	TDD	O&M
1	489	9						15	1,800	14-20				
2	378	8						16	600	14-20				
3	900	8						17	1,200	14-20				
4	47.5	9						18	440	14-20				
5	1,100	14-20						19	3,000	14-20				
6	750	14-20						20	337.1	14				
7	350	14						21	295	9.5				
8	500	14						22	600	14-20				
9	500	14						23	750	14-20				
10	270	14						24	750	14-20				
11	1,045	14						25	448	14				
12	500	14						26	570	14				
13	500	14						27	582.9	14				
14	2,400	14-20												

27 Projects in Taiwan 21.1 GW

On different Phases Operation, Construction, Tender, Early Stage



# Project Development Services

## Services

As more offshore renewable energy markets emerge, understanding, evaluating and securing project sites are extremely important tasks for developers. New markets bring new risks, but also new players and as offshore wind grows it becomes ever more competitive.

Via our OWC service business we support:

- The understanding new markets
- Site screening and selection
- Project concept development
- Bid preparation
- Supporting early development stages

We work with your team in the way that makes the most sense – either as a technical advisor or embedding into your development team.



## Renewables segments covered

### Fixed OWFs



### Floating OWFs



### Floating Solar



### Wave & Tidal



## Recent experience

OWC has and is providing PDS for clients in UK's Round 4 & ScotWind leasing rounds and also in Poland, Japan, Taiwan and other jurisdictions.

# Project Development Services

## Services

- **Understanding new markets**
  - Tailored studies or reports; either as a formal deliverable or in a workshop environment to clients exploring market potentials
- **Site screening and selection**
  - Initial site prospecting with GIS-based constraint analysis approach
  - Preliminary resource analysis
  - Grid connection options (availability, onshore substations, timing, landfall areas, offshore cable routing, competing projects, HVDC vs HVAC)
  - Environmental and permitting constraints (aviation, defence, O&G infrastructure)
  - Other important siting factors and provide developers with rank-ordered development opportunities within a set geographical region
- **Cost modelling**
  - Development of refined DEVEX, CAPEX and OPEX models
  - Project LCOE calculation

- **Project concept development**
  - Identify the preliminary project boundaries
  - Undertake desktop consenting
  - Desktop geotechnical studies
  - Wind turbine selection study
  - Early conceptual design, site screening and pre-feasibility assessments / heat mapping wind resource assessment
  - Foundation screening to reduce the technical, cost uncertainties taking into consideration the site-specific physical conditions
- **Electrical architecture and related infrastructure**
  - The transmission technology (HVAC/HVDC)
  - Sizing and siting of offshore substation(s)
  - Export cable route optioneering
  - Landfall and grid connection point identification
  - Port & harbour/supply chain analysis
  - Undertake high-level O&M Concept



## Owners Engineering

### Services

When developing offshore wind farms it is vital to mitigate risks from day one. In doing so you need to fully understand all the risks associated with the project.

What we do:

- Specify project requirements
- Evaluate and understand the specific site conditions
- Technology evaluation
- Prefeed and FEED processes
- Risk management
- Contract strategy

For developers stretched and / or without adequate in-house resources available or new to the sector, we can provide the specialist guidance required during the development and construction phases through to commissioning and generation.

We cover the entire process and can either monitor or consult on a project on your behalf, or supplement your own team being fully involved in all aspects of the project.

### Renewables segments covered

#### Fixed OWFs



#### Floating OWFs



#### Floating Solar



#### Wave & Tidal



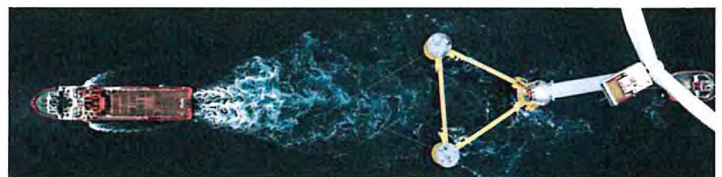
### OWC

ABL Group company OWC delivers **owner's engineering on fixed and floating projects in Europe, Asia and the US**. We support and ensure your project will run **on time and on budget** and will meet your objectives.

## Owners Engineering

### Services

- Site conditions and measurement
- Consents and environmental management
- Contracting strategy support
- Concept design, PreFEED and FEED
- Site investigation management
- Wind turbine selection
- Capex & Opex Assessment & Reviews
- Detailed design reviews and interface management
- Assurance strategy including project certification
- Electrical, grid and transmission
- Installation Concept Reviews
- Package Management (WTG, Inter Array Cable, Foundation, Export Cable, Onshore Grid Access, Construction, Site Investigation (soil, wave, wind), Certification, Design)
- Construction monitoring including site representation, progress monitoring, factory inspections and verification of works quality control and tests on completion
- Contract claims management
- Risk management
- Health and safety management
- Shipping and factory inspections
- Site inspections from mobilization through to commissioning, testing and take-over
- Defects and punch-listing
- Warranty, operations and maintenance support
- Preparation of Contingency Plans (Repair, maintenance & contracting strategies)



# Construction Supervision and Offshore Project Management

## Services

We provide teams to work throughout the construction or conversion of an offshore asset. The offshore project management team monitors the project to ensure that it is carried out in accordance with the contract, the specifications, client's expectations, flag and class requirements. Our services incl.:

- Detailed design review
- Development and implementation of project procedures
- Review of machinery and equipment purchase orders and specifications
- Development and implementation of project execution plans
- Monitoring of work progress and testing activity
- Monitoring of quality control of each activity throughout the construction
- Attendance at formal safety meetings
- Attendance at Factory Acceptance testing (FAT)
- Audits of subcontractor's facilities
- Attendance during sea trials and inclining experiments
- Reporting to the Client on a weekly and monthly basis
- Tracking of site queries, observing safety policy, monitoring quality control measures
- Maintaining electrical & mechanical completion and commissioning records and database
- Monitoring and reporting on extras and credits

## Sectors covered



## Qualification of staff

The offshore project management team consists of key personnel with the necessary skills to ensure that the construction meets the build schedule.

We provide teams of **experienced engineers and inspectors** of various disciplines to be utilised at different stages of the project. In addition, **dedicated planning and document control** functions are provided throughout the duration of the construction phase.

# Technical Due Diligence

## Services

**Our combined unparalleled technical and commercial expertise makes us a trusted resource during the due diligence phase of any renewables, marine or oil & gas acquisition.**

Services include:

- Market studies
- Pre and post contract reviews
- Assessment of project schedule feasibility
- CAPEX and/or OPEX budget evaluation
- Grid connection and PPAs
- Evaluation of operating and maintenance costs
- Review of logistic concepts for construction and operation
- Review of geophysical and technical-studies
- Review of Energy Yield Assessment (EPA) including check of applied uncertainties and technical loss factors
- Technology assessment
- Monitoring - construction and operational

## Sectors covered



## Offshore wind

OWC offers **specialist technical due diligence** supporting the financing, acquisition, sale and refinancing of assets, technology and companies within the offshore renewables market. **We have experience of offshore wind projects and value chain M&A from Europe to Asia.**

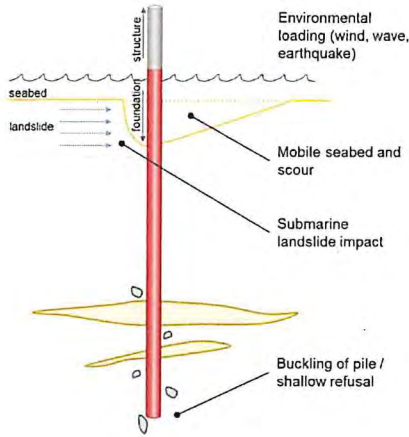
With our assistance, owners and financial institutions can obtain an objective expert view on the **actual project performance or asset value**, as an important input to the decision-making process related to loans, consolidation or acquisitions.

# Geotechnical and Geophysical Consulting

## Services

ABL Group are expert at site characterisation strategies, offshore site investigation (both geophysical and geotechnical), offshore site investigations, geotechnical design, installation analysis and jack-up leg penetration analyses for offshore oil and gas and wind turbine foundations.

- Ground Modelling & Geotechnical Interpretation
- Geospatial Analysis
- Geotechnical Design
- Foundation Installation Analysis
- Cable Route Analysis and Planning
- Jack-Up Leg Penetration Analyses
- Seismic Engineering
- Quantitative Risk Assessment
- Geospatial Data Management



## Sectors covered

### Renewables



### Oil & Gas



## Leading geoscience consultancy

OWC, East Point Geo and Longitude are leading geoscience experts across offshore and onshore wind, oil and gas and subsea power interconnectors.

- 48 offshore wind projects of experience
- Peat landslide risk assessments / peat management plans / peat probing for onshore wind (incl. SSE, SPEN, Innogy, Coriolis, Statkraft, EnergieKontor, Infinergy)
- Platform and pipeline field development, ground model, geotechnical planning and interpretative reporting, seismic hazard analysis, foundation soil reaction spring assessment (Caspian Sea, UBOC)

# Geotechnical and Geophysical Consulting

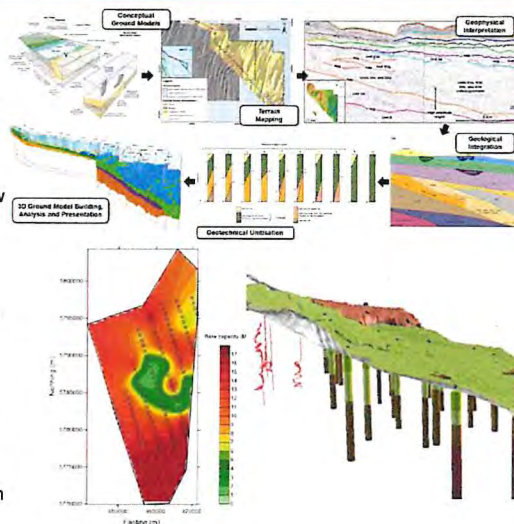
## Services

### Ground Modelling & Geotechnical Interpretation

- Building of early stage ground models
- Iteratively update & incorporate factual and interpretive geo-data, incl. morphological (terrain), geophysical (subsurface) and geotechnical (soil) datasets
- Geohazard assessments and drilling/shallow hazard assessments and represent the results within 4D ground models

### Geospatial Analysis

- Spatially quantify the interaction of infrastructure using statistical and analytical models
- GIS to perform site-wide foundation screening
- GIS-based slope stability screening for geohazard assessment, sediment transport modelling, least cost routing analysis for pipeline/cable route optimisation and 3D volume difference calculations for excavation / fill applications.



### Geotechnical Design

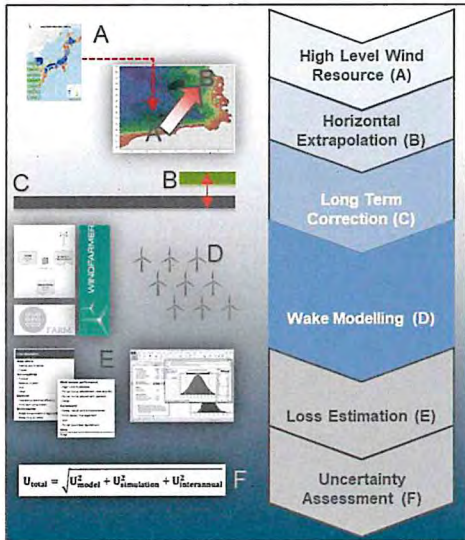
- Offshore foundation design of monopiles, jacket piles, gravity bases, mat foundations, ground anchors and suction caissons
- Finite Element Modelling
- Seismic and liquefaction assessment
- Foundation Installation Analysis
- Pile driveability assessments
- Site supervision during foundation installation
- Pile driving induced fatigue analysis
- Seabed preparation advice

### Mudmat design

- Cable Route Analysis and Planning
- Design and management of cable routes, ensuring the effective protection of the cable system throughout its design life
- Cable Burial Risk Assessments (CBRA)
- Installation methodologies

# Resource Assessment

## Services



OWC's wind & site services include amongst others:

- Early **conceptual** design, site screening and pre—feasibility assessments/heat mapping
- **Ensemble** wake modelling with validated models and evaluation of blockage effects
- Layout and turbine **optimisation** to maximize your cost-benefit function
- **Tailored mesoscale** modelling
- **Probabilistic** loss and uncertainty assessments with Monte Carlo simulations
- Wind **resource** assessments for designated wind farm areas
- **Bank-grade** wind resource assessment and energy production assessments
- Post—construction **operational** yield assessments for refinancing or M&A including portfolio analysis
- Third—party energy yield **reviews** and red flag analysis

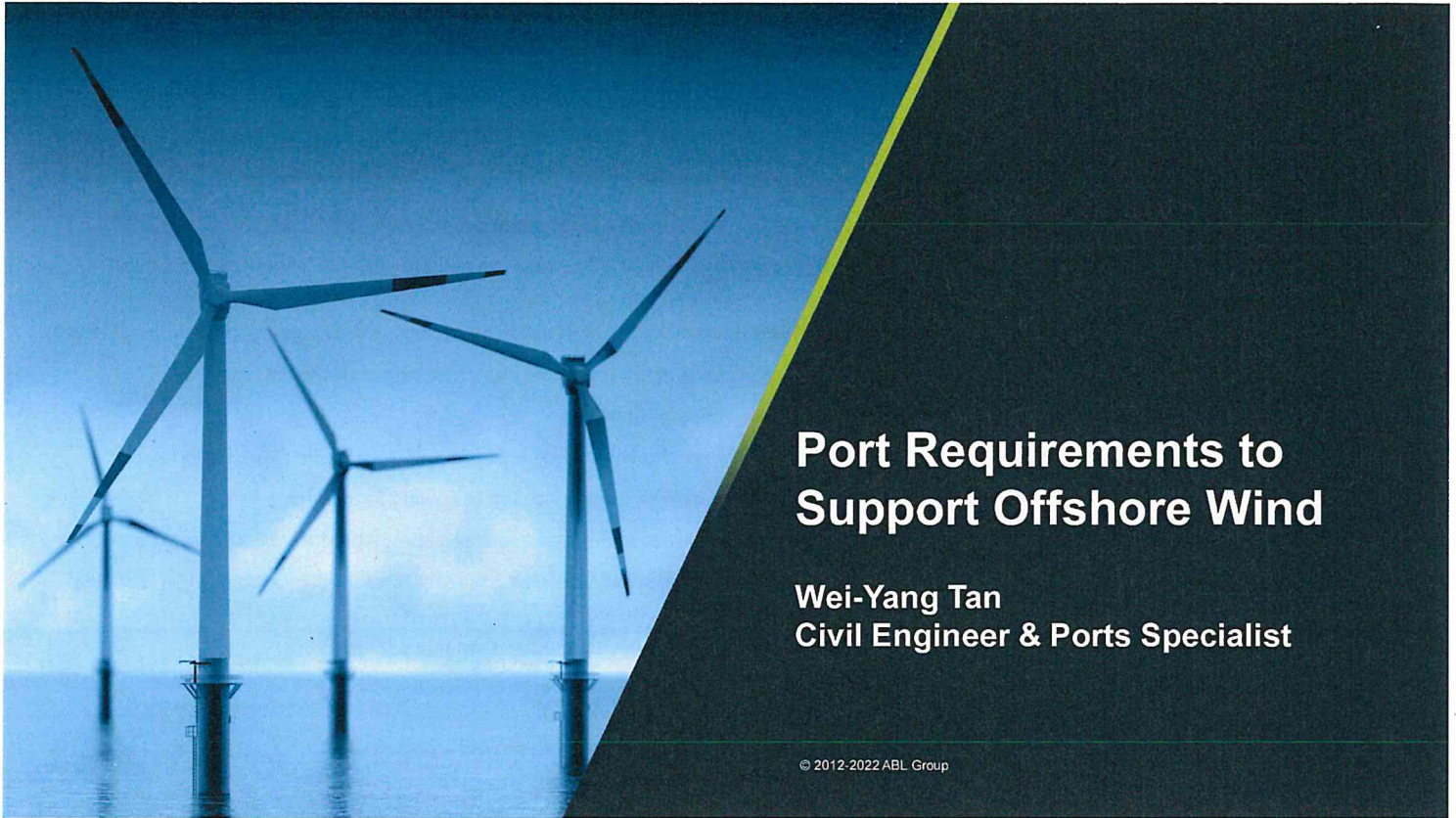


# Wind Measurement

## Services

- Review of existing available data
- Recommendation of detailed wind measurement strategy
- Management of tender process for wind measurement devices
- Management of wind measurement campaign
- Processing of measurement data & production of metocean report





# Port Requirements to Support Offshore Wind

Wei-Yang Tan  
Civil Engineer & Ports Specialist

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## Industrialization of Massive Structures for Giant Turbines

Industrialization of floaters becomes a challenge:

- Required port areas with capabilities (quay space, draught, bearing capacity)
- Takt time (time/demand)
- Required means
- Launching means
- Supply chain & Local content

Opportunities:

- Prefabrication at different site(s) and use of multi-purpose Port area(s)
- Introduction of new materials
- Just in time production
- New wet storage areas
- New launching means & technologies





# Floating Foundation Types

**Spar**  
Hywind (Equinor)  
Toda corp.

**Semisub**

- Windfloat (Principle Power)
- Olav Olsen
- Seareed (Naval Energies)
- Voltorn (Aquaventus)
- Vshape (MHI)
- Trifloater (Gusto MSc)

**Barge**

- Dumping pool (Ideol)
- SATH (Saitec)

**TLP**  
SBM  
Offshore

**Semispar**

- Tetraspar (Stiesdal)
- Hexafloat (Saipem)
- Esteyco

**Multiturbine**

- Hexicon
- Nezy (Aerodyn)
- W2P



# Port Infrastructure Capability Engagements



CRITERIA	Value	Port
<b>WIND FULFILL ASSEMBLY PORT - HULL/F</b>		
<i>Key criteria</i>		
Minimum quay length	XXX m	
Minimum channel and quay water depth	-Xm CD	
Minimum channel width	XXX m	
Minimum air draft	Xm	
Shallow deep water for faster storage	-Xm CD	
<i>Ranking score A</i>		
<i>Operational criteria</i>		
Facilities available	Yes/No	
Port movement restriction (day/night, etc)	Yes/No	
Third party vessels operating at adjacent berth	Yes/No	
Minimum water depth available for full float off from stem	XX m	
<i>Ranking score B</i>		
<b>Total offshore full assembly ranking score A+B</b>		
<b>WIND FULFILL ASSEMBLY PORT - GASTRIFT</b>		
<i>Key criteria</i>		
Minimum quay area	XX,000 m <sup>2</sup>	
Minimum quay load capacity	XX t/m <sup>2</sup>	
Minimum storage area	XX,000 m <sup>2</sup>	
Minimum storage area load capacity	X t/m <sup>2</sup>	
Minimum width of corridor between storage area and quay	XX m	
Unrestricted access to port	Yes/No	
<i>Ranking score C</i>		
<i>Operational criteria</i>		
Maximum distance from laydown area to quay	X km	
Presence of internal storage facilities, yard area	Yes/No	
Shore crane availability for key criteria	Yes/No	
Office space	Yes/No	
Crane parking facilities	Yes/No	
Workshops	Yes/No	
Ability to dry dock or shipyard facilities in port	Yes/No	
Crane accommodation	Yes/No	
<i>Ranking score D</i>		
<b>Total offshore full assembly ranking score C+D</b>		
<b>Total full assembly score A+B+C+D</b>		



## Port Infrastructure Capability Assessments

The colour-coding used here aligned with the following descriptions:

**GREEN** Port appears potentially suitable on the basis of key criteria with no or minimal minor modifications and could be considered for further detailed assessment and port engagement.

**AMBER** Some constraints to key criteria exist and port would not be considered suitable without some further support, enhancements, modification or clearances. Constraints identified were either considered non-prohibitive or minor to moderate in nature which could potentially be resolved.

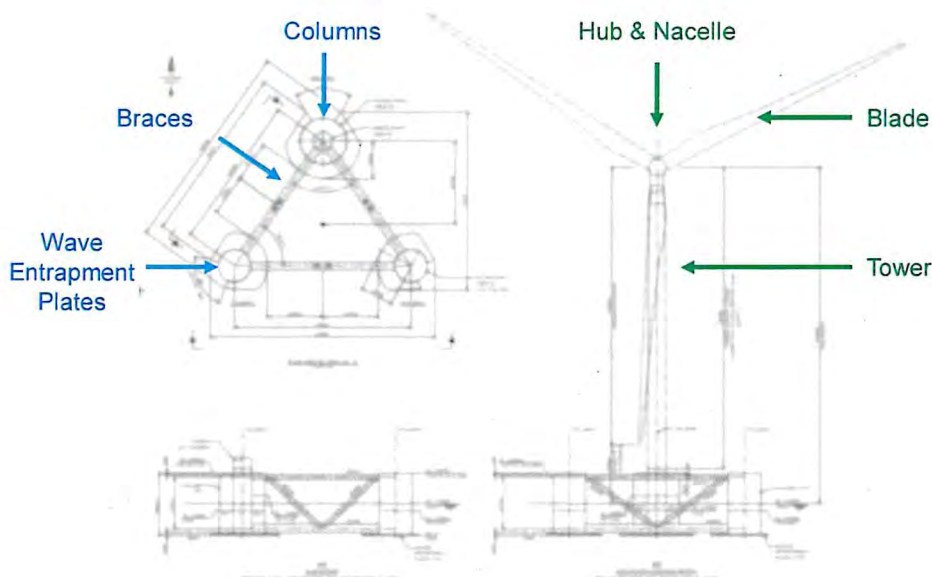
**RED** Ports not considered suitable and does not meet multiple key constraints. Port would require significant changes, modifications, developments clearances. Constraints identified were either considered prohibitive or major in nature which were unlikely to be resolved in time.

Location: Harbour, UK. Approximately XX NM to the site centroid.

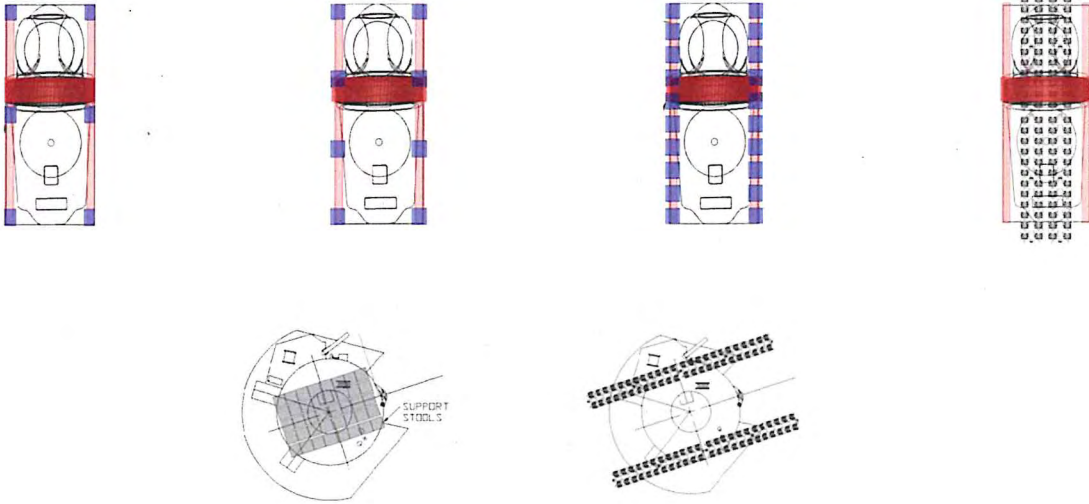


As Is	Development Plans	
<i>(Text is illegible)</i>	<i>(Text is illegible)</i>	
Key Considerations	Additional Notes	
<i>(Text is illegible)</i>	<i>(Text is illegible)</i>	
As Is.	Assembly	Integration
Future.	Assembly	Integration

## Turbine & Foundation Characteristics – Assembly & Integration



## Port Infrastructure Storage Capacity



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## Foundation Assembly – Dry Dock

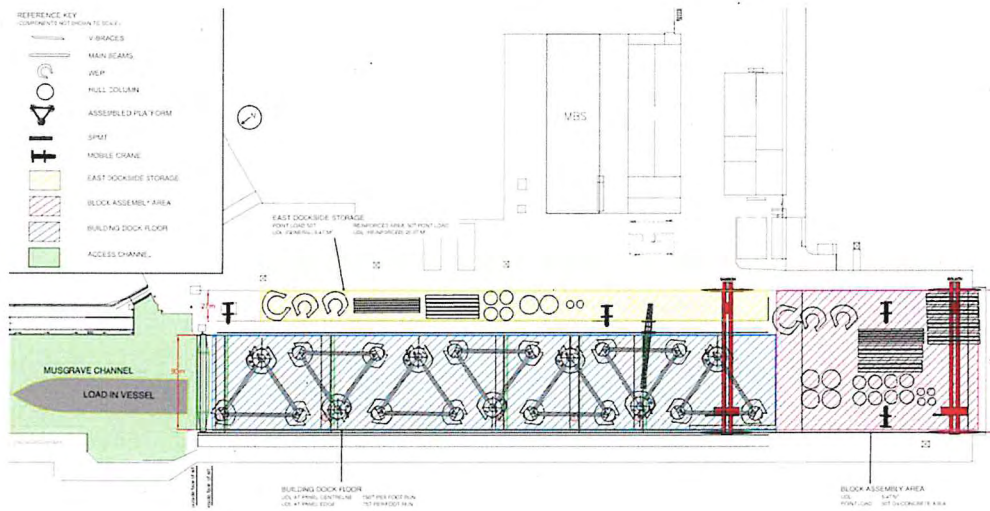


Credit PPI / Dock90 (WFA Lisnave, Portugal)

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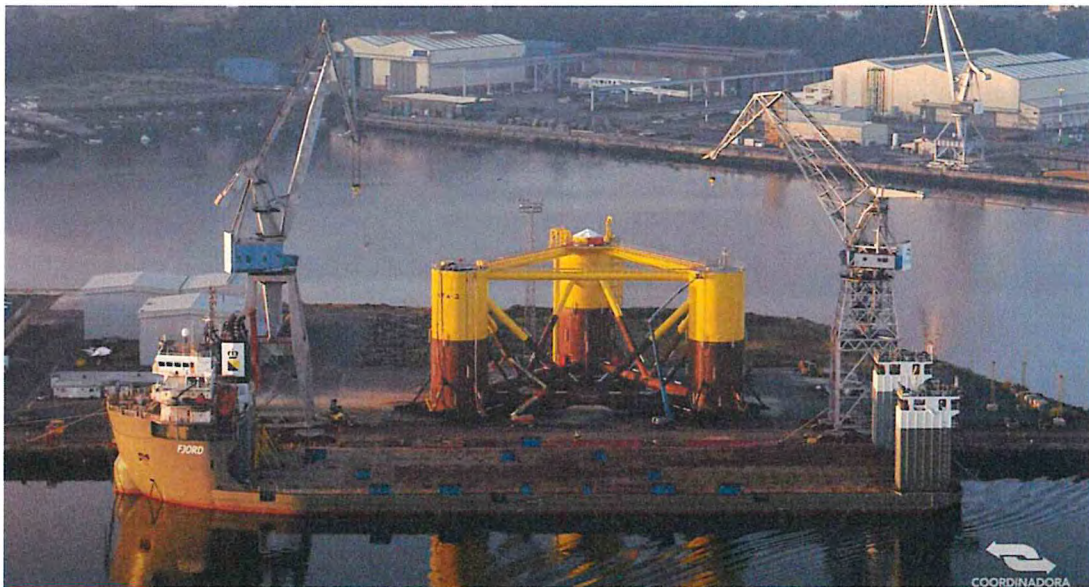
## Foundation Assembly – Dry Dock



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## Foundation Assembly – Quayside Loadout

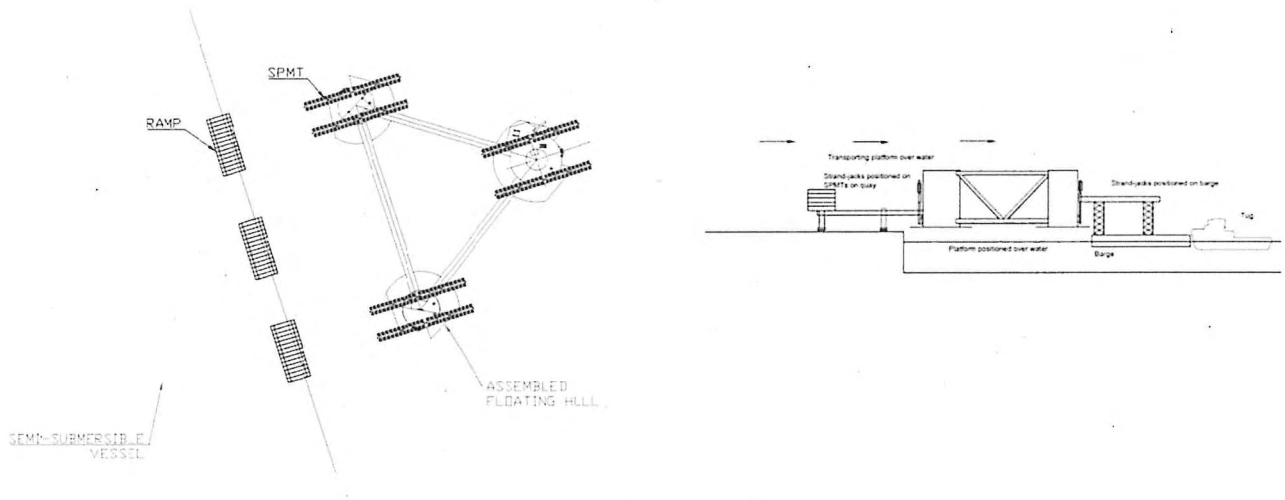


Credit Coordinara (<https://www.youtube.com/watch?v=-eLU4if9MaQ>)

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## Foundation Assembly – Quayside Loadout



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## Foundation Dry Tow



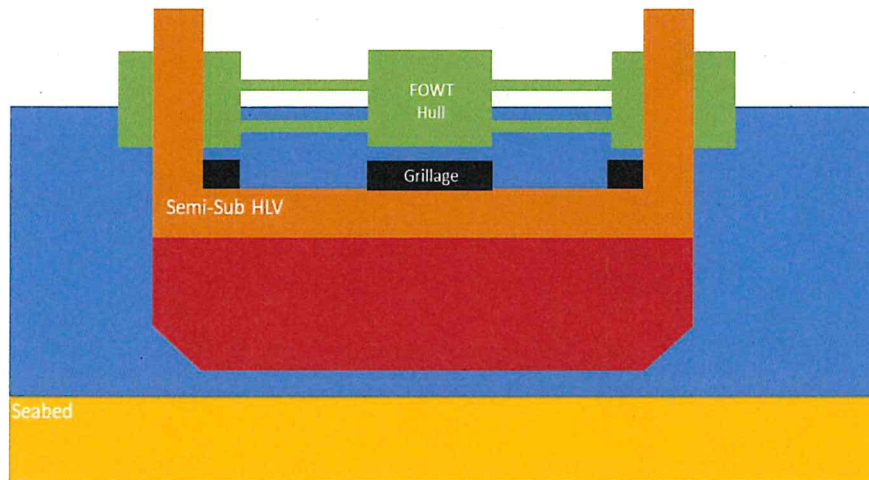
Credit Coordinara (<https://www.youtube.com/watch?v=-eLU4If9MaQ>)

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## Foundation Dry Tow - Clearances

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## Turbine Integration - Quayside

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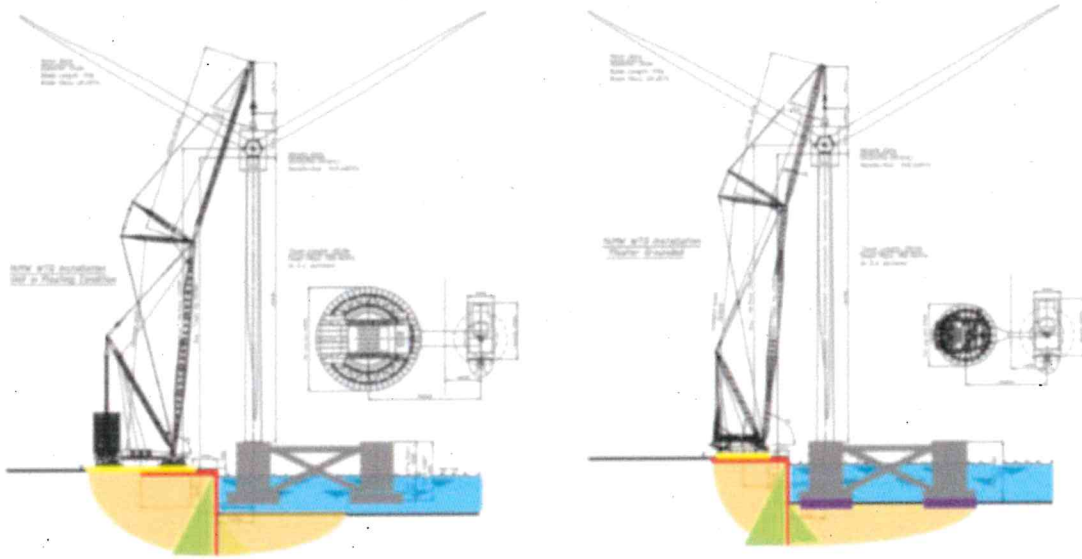
Credit Coordinara (<https://www.youtube.com/watch?v=-eLU4if9MaQ>)

40



## Turbine Integration – Floating / Grounded

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41

**ABL**

## Integrated Turbine - Wet Tow

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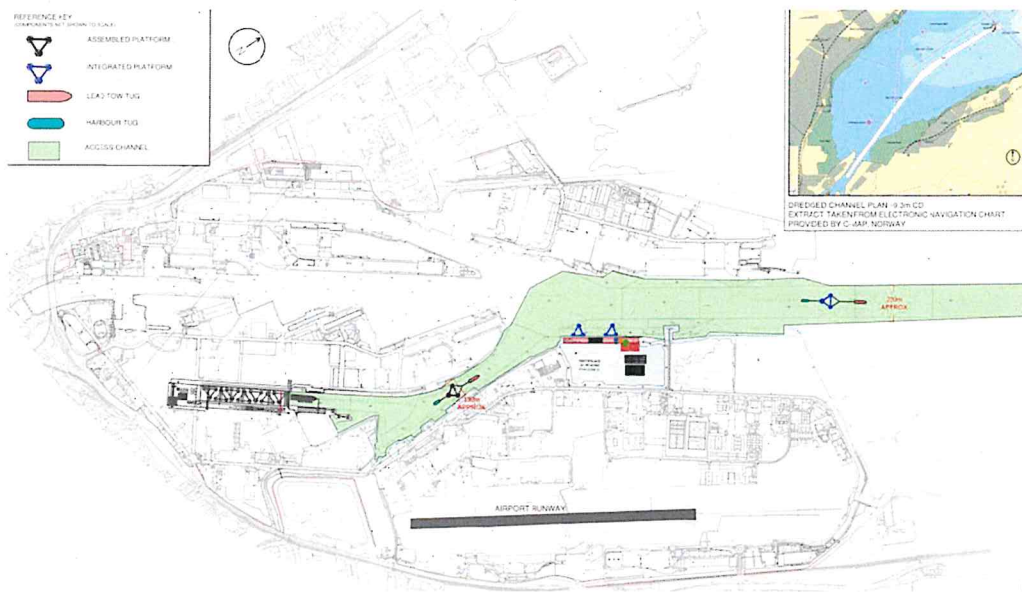


Credit PPI / Dock90

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**ABL**

# Integrated Turbine - Wet Tow



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**Marine Warranty,  
Transport &  
Installation services**  
Mike McLachlan  
Renewables MWS Director: Europe  
and UK

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## Role of the Marine Warranty Surveyor

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“The fundamental objective of the **Marine Warranty Surveyor** is to make **reasonable endeavours** to ensure that the risks associated with the warranted operations to which a Warranty Surveyor is appointed **are reduced to an acceptable level** in accordance with best industry practice.”

*JR2021-028 - “Joint Rig Committee Marine Warranty Surveyors’ Code of Practice, Renewables Scope of Work and Renewables Certificate of Approval Requirements and Examples”*



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## Warranty Surveying

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- MWS is independent and employed by the “Assured” on behalf of the CAR Underwriters to allow the benefit of insurance excess deductibles to the Contractor
- Working for the underwriter
  - Eyes and ears on the ground
  - Application of best practise
- Design and procedure verification
  - In-house review
  - Suitability surveys of assets
  - Verification on-site
- Operations
  - Loadouts
  - Transportation
  - Installation (Loadout, Installation, Protection)



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## MWS Renewables High-Profile Track-Record



Offshore Wind



Floating Offshore Wind

- Hornsea 1
- Hornsea 2
- Moray East
- Moray West
- Borwin III
- Borssele III and IV
- Gemini
- RaceBank
- Gwynt y Mor
- Greater Gabbard
- St Nazaire
- Global Tech 1
- Rampion
- West of Duddon Sands

- Galloper
- Sheringham Shoal
- Rentel
- Amrunbank West
- SandBank
- Lincs
- Fujian Pinghai Bai 2
- Humber Gateway
- Northwester 2
- Arcadis Ost
- Codling
- Neart na Goith

- Northwind
- Rodsand 2
- Robin Rigg
- Gunfleet Sands
- Belwind
- Belwind 2
- Westemeerwind
- Kentish Flats
- Luchterduinan
- Lillgrund
- Riffgat

- Falck 547
- Floatgen
- Gray Whale
- Les Eoliennes en Mer
- Ulsan
- Valorous
- Windloat
- Windfloat Atlantic

## ABL Group Experience in Taiwan

### MWS

- Taipower 2
- Changfang
- Formosa 2
- Greater Changhua
- Xidao

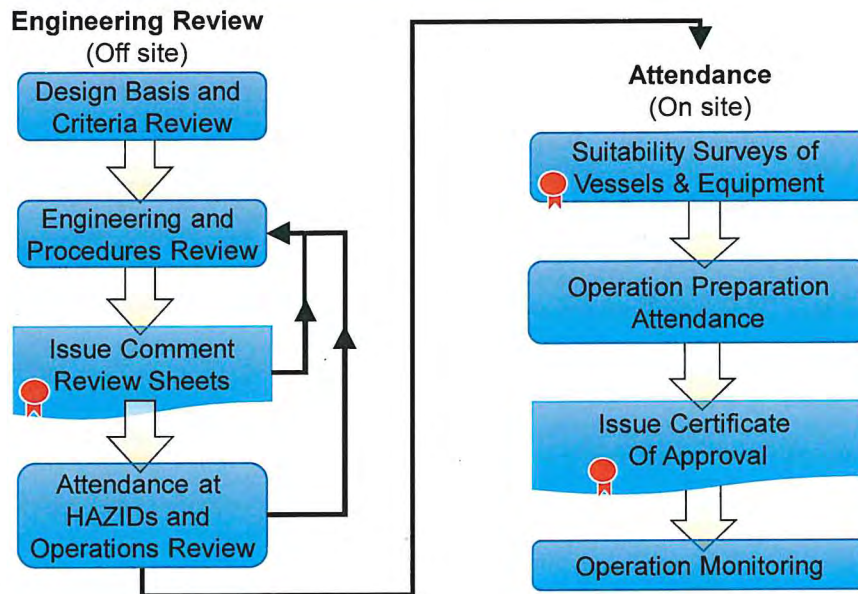
### Engineering Support or Advice

- Changfang
- Formosa 1 Phase 2
- Guanjin
- Taichung (RWE)
- Hsinchu (RWE)
- Formosa 3 Haiding 1
- Formosa 3 Haiding 2

### Engineering Support or Advice

- Formosa 3 Haiding 3
- Meishen (Enervest)
- Hai Long (NPI)
- JiaNeng (NPI)
- BeiNeng (NPI)
- Da Chung Bu (Iberdrola)
- Guo Feng (Iberdrola)
- Site 7 (Vena)
- Site 13 (Vena)
- Huan Yang(Taiya)

## The MWS Approval Process

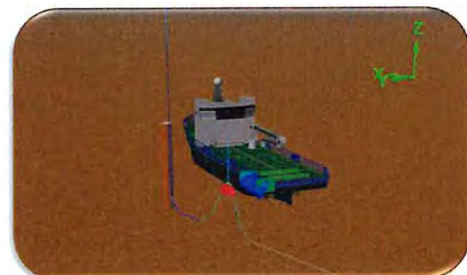
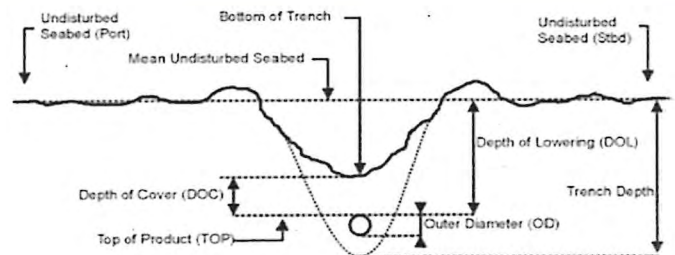


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## Document Review

- Typical Engineering Documents
  - Cable Specifications
  - Cable Handling Guidelines
  - Route Engineering
  - Surveys
  - UXO Alarm
  - Basis of Design
  - Installation Analysis
  - Transportation Analysis
  - On bottom stability
  - Cable burial risk assessment
  - Burial Selection
  - Lift Engineering
  - Site Specific assessments
  - Metocean Reports
- Typical Operational Documents
  - Installation Procedures and RA
  - Task Plans
  - Storyboards
  - Weather Procedures

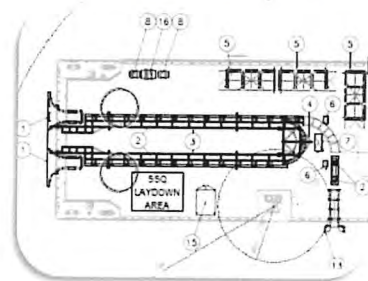


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## Vessel and Equipment Suitability Surveys

- Large database of previous surveys
  - Desktop review for early advice
- Pragmatic Approach
  - Use of local surveyors but ABL Standard template
  - Experienced in the required operations creates ability to focus on key items
  - Concentrate on Project Requirements
  - Dedicated DP Specialists if required
  - If not all equipment onboard during Survey may require a two stage approach
- Vessels
  - Cable Lay Vessel or barge
  - AHT
  - BSV
  - Tugs
  - Installation Vessels
  - Barges
  - Walk to work vessel



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## Scope of Work – Subsea Cables

- Cables – From LR2021-028
- Export and Inter Array
  - Loadout
  - Shore end pull in (Export)
  - Export cable – 100%
  - First in series cables Inter Array– 20% overall and includes more than one attendance
- Cable Protection
  - Wet test and calibration/trials
  - Start up of operations – at least two burial operation per shift

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## Scope of Work – Foundations and WTG

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- Foundations
  - Loadout
  - First in series. - 20% overall and includes more than one attendance
- WTG
  - Loadout
  - First in series. - 20% overall and includes more than one attendance

## Scope of Work – Offshore Substation

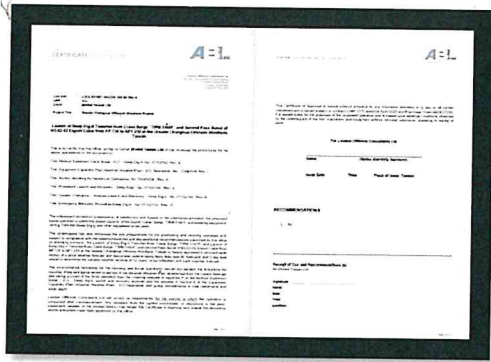
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- Foundations
  - Weighing
  - Loadout
  - Offshore Attendance 100%
- Topsides
  - Weighing
  - Loadout
  - Offshore Attendance 100%

# Operational Approval

## Certificate of Approval for Operations

- Loadout of Components
- Transportation of Components
- Offshore Installation



## Requirements for Certificate of Approval

- Engineering and procedural documentation approved
- Vessels and equipment surveyed and approved
- Environmental conditions suitable
- Weather window available
- Final briefing or tool box talk completed
- Witnessed preparations for operation



## Questions / Discussion

Tim Camp [tim.camp@owcltd.com](mailto:tim.camp@owcltd.com)

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Wei-Yang Tan [wei-yang.tan@abl-group.com](mailto:wei-yang.tan@abl-group.com)

Mike McLachlan [mike.mclachlan@abl-group.com](mailto:mike.mclachlan@abl-group.com)

[abl-group.com](http://abl-group.com)

INNOVATE UK







# Taiwan-UK Innovation Collaboration

Dr. Matthew Blackmur CEng CSci MIMMM  
Innovation Lead - Energy



## UK in a global world

The Opportunity:

- 99% of population live elsewhere
- 97% of WW GDP is elsewhere

What will we have to offer in future?

- Stuff we dig up?
- Stuff we grow?
- Our manual labour?
- High value products & services?



UK  
RI



Innovate  
UK

# Welcome



# EPSRC

1926 - 2022

UK  
RI

Innovate  
UK

# Innovate UK

- We are the UK's innovation agency
- We support business-led innovation in all sectors, technologies and UK regions
- A key delivery body of the Government's Innovation Strategy

## Our Mission

To help UK businesses grow through the development and commercialisation of new products, processes, and services, supported by an outstanding innovation ecosystem that is agile, inclusive, and easy to navigate.



## Benefiting everyone through knowledge, talent and ideas

UK Research and Innovation brings together the 7 Research Councils, Innovate UK and Research England.

As part of UK Research and Innovation, Innovate UK drives productivity and economic growth by supporting businesses to develop and realise the potential of new ideas including those from the UK's world-class research base.



**UK Research and Innovation**



# Inspire

Make the opportunity visible and compelling

# Involve

Bring relevant organisations and people together

# Invest

Convene the resources needed, including our own








## Our Four Criteria

1. Large global market; accessible
2. Strong UK Capacity; relative
3. Timing; appropriate
4. Added-Value from our involvement



# Our Priorities

## Strategic Themes

 <p>Future Economy</p>	 <p>Growth at Scale</p>	 <p>Global Opportunities</p>	 <p>Innovation Ecosystem</p>	 <p>Government Levers</p>
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## Strong Foundations



 <p>Science &amp; Research Strengths</p>	 <p>Design Expertise</p>	 <p>Societal Impact &amp; Responsible Innovation</p>	 <p>Innovation Talent &amp; Skills</p>	 <p>Equality Diversity &amp; Inclusion</p>	 <p>Place &amp; Levelling Up</p>
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# Working in Partnership

Making it easier for businesses to go faster



- Business innovation is difficult
- Help and expertise are available from multiple places
- We are working with partners to deliver the [Plan for Action](#)

# Our Impact

## Confidence in the Plan for Action



### Growing Companies

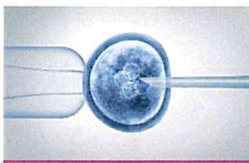
Through our programmes, we have invested £4.6bn in 12,000 companies, helping to create over 100,000 jobs and contribute £32.2bn in added value to the UK economy (a 7:1 return).

### Building Sectors

We have helped the UK lead the way in new industries that are fundamental to our future prosperity.



We helped make the UK a world leader in offshore wind – now generating more than 10% of UK electricity.



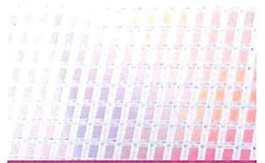
We helped build the third largest cluster of cell and gene therapy companies in the world.



We helped attract more than £1.8 billion private investment for synthetic biology start-ups between 2014 and 2019.



We helped London grow into a world centre for the visual effects industry and open new studios across the UK.



We helped a semiconductor cluster in Wales contribute £172 million to the Welsh economy in 2020 and is supporting 2,100 jobs.



Investment of  
**£4.6bn**  
since 2007

Industry match funding taking the total value of projects above

**£7.5bn**

Up to  
**£32.2bn**  
in added value to the economy

Up to  
**£7**  
for every £1 we've invested

We've funded over  
**15,000**  
projects

**11,800**  
unique organisations involved

**9 jobs**  
at each organisation involved

More than  
**100,000**  
jobs created since 2007

# ACT Blade: boosting wind energy through sailing technology

An Innovate UK-backed start up has developed a lighter wind turbine blade that could generate more power, cost-effectively.

## Who?

ACT Blade is a Scottish start up developing blades for the wind turbine industry with funding from Innovate UK.

## What?

Inspired by ship sails, these blades are made of textile. This results in a lighter product that, unlike other blades, can be easily disassembled and recycled.

## Why it matters

As well as helping to reduce landfill waste in the renewable energy sector, ACT Blade's product could boost energy production by nearly 10%.

An aerial photograph of a lush green forest. A narrow path or stream winds through the trees. In the lower right, a small blue and white boat is visible on the water. The text 'An Opportunity to Collaborate' is overlaid in white on the left side of the image.

# An Opportunity to Collaborate

## Our five steps to internationalisation

Global  
Scoping  
Workshops

Global Expert  
Missions

Global Business  
Innovation  
Programmes

Global  
Incubator  
Programme

Bilateral and  
multilateral  
Funding  
Programmes



### UK-US bilateral offshore wind competition

The US is a large market opportunity for UK offshore wind innovators.

Innovate UK partnered with NOWRDC, a US Department of Energy body created to fund collaborative R&D projects.

The UK competition has just closed with 4 UK projects awarded funding to work with US projects.

This initiative will create opportunities for further UK-US research and business partnerships.





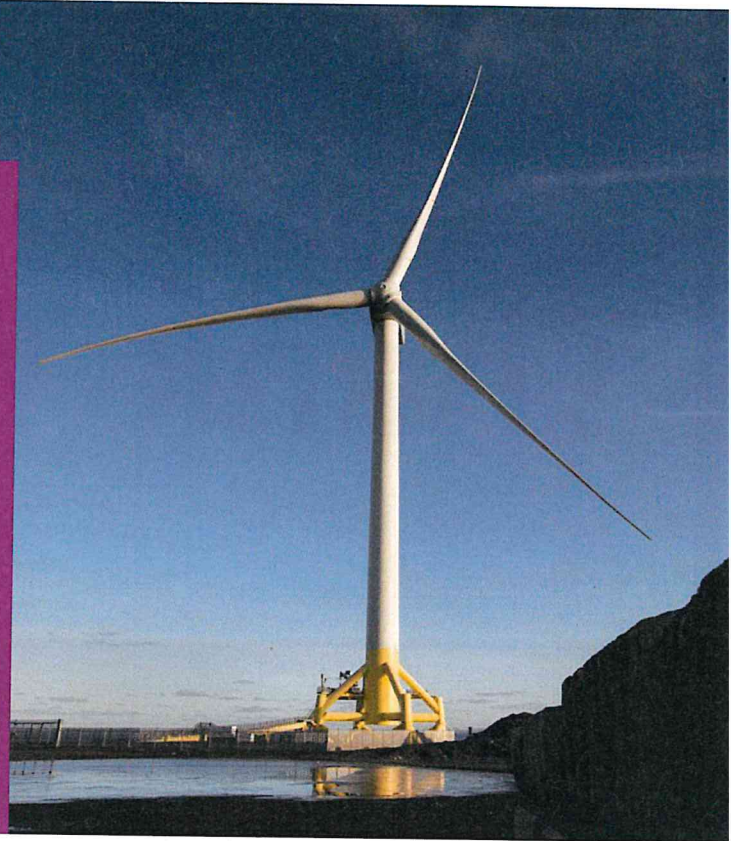
## UK-US Floating Offshore Wind

ATLANTIS phase 1 is a US floating wind R&D programme.

Projects aim to develop new and potentially disruptive innovations in FOWT technology to enable a greater market share of OW.

The first UK-US project on DC Grid Topologies has commenced.

Innovate UK is discussing an extension to this collaboration to support funding of additional UK-US R&D projects.



**Offshore Wind is a key opportunity for collaboration.**

We welcome an exploration of opportunities to co-invest in collaborations between the UK and Taiwan.



# Thank You

Download the  
Plan for Action



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