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Taiwan Offshore Wind

Specialist technical issues affecting project development in Taiwan

4th Asia Offshore Wind Day

Asia Wind Energy Association

18 September 2018

Presenters

Miguel Torres

- **Offshore Wind Specialist** at Mott MacDonald Taipei office
- **Chartered Civil Engineer** with extensive experience in execution of projects offshore both for **Wind** and **Oil & Gas**
- Experienced in offshore wind farms for **fixed** and **floating concepts**
- **20 years experience** developing different projects globally for the energy industry both offshore and onshore

David Huang

- **Renewable Energy Engineer** at Mott MacDonald Taipei office
- Taiwan local **Mandarin/English** bilingual Engineer
- **4+ years of experience** specializing in **Wind Energy projects** acting as Project Manager, Project Engineer and Renewable Energy Engineer
- Previously worked in UK offshore wind sector, Mott Thailand energy team, and offshore wind developer in Taiwan

Agenda

1. Brief Introduction to Mott MacDonald

2. Offshore Wind Supply Chain -
   "An overview of Taiwan and key challenges"

3. Environmental and Social -
   "Compliance with Equator Principle"

4. Steel Structures -
   "Technical local challenges"

5. Ports and Harbours -
   "Considerations for Taiwan offshore wind"

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We’re a global engineering, management and development consultancy focused on guiding our clients through many of the planet’s most intricate challenges

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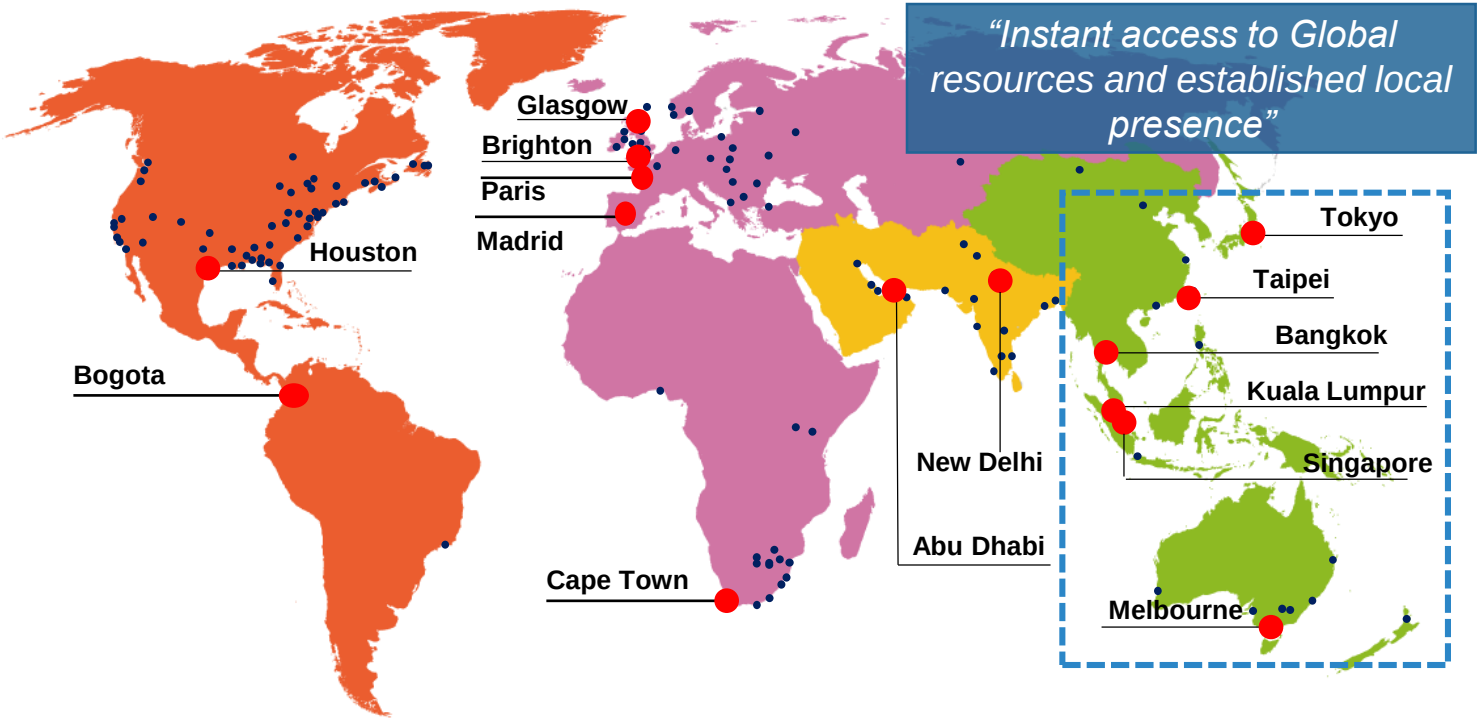
Regional and International Energy Capacity



85GW

Engineering and technical advisory services for over 85GW of wind energy projects worldwide, including 10GW in Asia Pacific and >1.7GW in Taiwan

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Offshore Wind Supply Chain

An overview of Taiwan and key challenges

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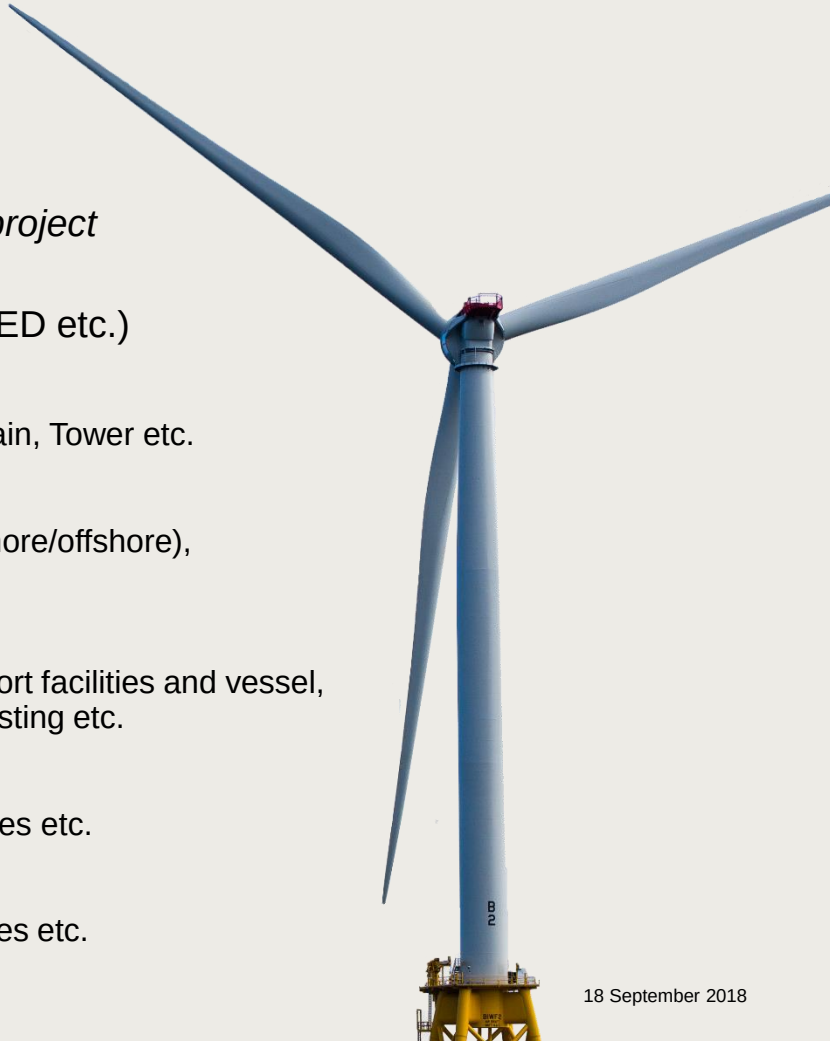
Offshore Wind Supply Chain

Typical Break Down

Typically broken into elements to reflect different stages of project life and typical contract boundaries

1. **Project Development and Management** (Survey and FEED etc.)
2. **WTG Supply** (Nacelle, Rotor and usually include Tower)
   - Turbine nacelle assembly, Blades, Castings and forgings, Drive train, Tower etc.
3. **BOP Supply** (Cable, Substation and Foundation)
   - Array and Export cables (subsea and onshore), Substations (onshore/offshore), Foundations (MP, Non-MP steel and GBS) etc.
4. **Installation and Commissioning** (WTG and BoP)
   - Manufacture facilities, transportation of components, installation port facilities and vessel, other sea-based support (MWS, navigational aids, weather forecasting etc.
5. **Operation and Maintenance Service**
   - Operations, Inspections and Maintenance, Minor and Major services etc.
6. **Other support infrastructures**
   - Full-scale test facilities, research, training and development facilities etc.



Offshore Wind Supply Chain

Status of Taiwan Supply Chain and supporting Policy

INDUSTRIAL DEVELOPMENT BUREAU, MINISTRY OF ECONOMIC AFFAIRS
經 濟 部 工 業 局

“Taiwan Offshore Wind Energy Industry Policy” released Jan 2018 by Industrial Development Bureau (IDB), Ministry of Economic Affairs (MOEA)

Established alliances comprising key local companies:

The Wind Team

- **27 alliance members** lead by **China Steel Corp. (CSC)**
- Facilitate the cooperation between domestic companies and WTG OEMs to develop local manufacture capacity

The Marine Team

- **35 alliance members** lead by **China Ship Building Corp. (CSBC)**
- develop marine capacity including supply of vessels and crews

“Promote the development of the offshore wind industry, develop local supply chain and target the Asia-Pacific market”

“Aiming to provide blade materials, vessels, towers, steel structures and key components and elements of offshore wind farm”

Offshore Wind Supply Chain

MM Experience from Europe - localisation

Localization opportunities limited to:

- Foundations and substructure and topside
- Towers
- Sub-components further down supply chain

Potentially also:

Dependant on market conditions and government appetite (order volume by region)

- Blade manufacture
- Nacelle factory

Critical to Quality components usually still shipped from abroad:

- Casting and forgings
- Drive train (main shafts, gearboxes and generators)

Opportunities to draw on Taiwan's existing industries

- Converters, controllers & power electronics
- Primary & Secondary steel fabrication (e.g. China Steel etc.)
- Glass fibre for blade manufacture (e.g. Swancor)

Offshore Wind Supply Chain

Taiwan Supply Chain challenges

How will the objectives of the "**Taiwan Offshore Wind Energy Industry Policy**" be achieved and implemented with the **Selection Round** local content obligations?

- **BoE:** how will localization obligation from Selection Round be assessed and how will compliancy be regulated?
- **IDB:** detailed study/assessment of current capacity, targeted growth and strategy to achieve objectives
- **Wind/Marine team Alliance Members:** development of required skillsets and technologies, involvement in project pipelines
- **Project Developers:** profit from appropriate local contents as part of procurement/contracting strategy
- **WTG OEMs:** economic gains in sourcing/developing local facilities for WTG components
- **Financiers:** Risk profile of local supply likely too high for bankability

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Environmental and Social

Compliance with Equator Principles

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Equator Principles

Projects in '**Designated Countries**':

- Compliance with relevant host country laws, regulations and permits that pertain to E&S issues.
- Host country laws meet the requirements of Principle 2, 4, 5 and 6

Projects in '**Non-Designated Countries**' **(Taiwan):**

- IFC Performance Standards on Environmental and Social Sustainability
- World Bank Group Environmental, Health and Safety Guidelines

Key Environmental and Social risks

Taiwan EIA – Gaps with EP

Cumulative impacts

All offshore wind projects

Associated facilities

TL/SS

ESMS

Grievance mechanisms

Capacity

ESMP, EPRP

Marine traffic
Underwater noise
Underwater heritage

Ecology

Critical habitat

Offsetting

Livelihoods

Ecosystem services

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Steel Structures

Technical local challenges

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Steel Structures

Overview

Typical Structures

- Foundations for WTGs and OSP
- Substructures for WTG and OSP (Jackets, Monopiles, Tripods, etc)
- Transition Piece
- WTG tower
- Topside for OSP
- Topside/Deck for WTG
- Secondary and tertiary

Project life cycle

- **Design**
- **Fabrication**
- **Transportation & Installation**
- Structural Integrity
- Decommissioning or reuse of FST

Source: Kriegers Flak Offshore Wind

Steel Structures

Design process

Design life cycle:

- Conceptual engineering (Preliminary engineering, Concept selection)
- FEED
- EPC (Detail design)

Source: /www.renewableenergyworld.com

Design requirements (local challenges):

- Typical requirements (WTG all load cases, wind, wave, current, T&I, operational, onsite, etc)
- Local challenges (typhoons, earthquakes, tsunamis, consenting requirements)

Looking ahead:

- Soil investigation – Define the right soil investigation strategy at an early stage.
  - Ground model approach effective for offshore wind farms

Steel Structures

Fabrication - Local challenges

Foundations and substructures for WTGs and OSPs (including topsides)

- Fabricators manufacturing capacity
- Fabricators location (close to the quay, etc)
- Readiness of fabricators
- Offshore fabrication experience
- Fabrication yard space requirements
- Welding capabilities (including testing requirements)
- Painting capabilities
- Special requirements for TP (fabrication and inspections)

Looking Ahead

- Pre-qualification of fabricators
- Serial fabrication (cluster approach)

Source: ww.smulders.com

Steel Structures

Transportation and Installation

“Finding the right T&I methodology for Taiwan”

Hoping for the best but planning for the worst

- Typhoons and monsoon, and winter season, only few months for installation
- Plans for different installation campaigns (piling campaign, substructure campaign, WTG campaign)
- Define a transportation method early to include it into the design (jackets, MP, tripods, OSP topside, etc)
- Load out requirements

Source: Westermeerwind

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Ports and Harbours

Considerations for Taiwan offshore wind

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Ports and Harbours

Key Considerations

General

***Types** and **availability** of equipment and vessel, and installation methodologies*

- **Vessel:** physical dimensions
- **Wind farm components:** physical size range

Port Usage

***3 Primary operations** where port facilities are needed during construction and operation*

1. Manufacturing; **2. Storage; 3. O&M**

Main activities

- **Assembly, Fabrication and Storage**
- **Base to support installation and O&M**

Logistics methodologies

*Large **components** usually manufactured in proximity to port facilities*

- Manufacture site → Port storage areas
- Manufacture → Stored on floating barge (near site) → awaiting installation
- Manufacture → Transport vessel → Installation vessel at site (Feeder operation)
- Manufacture → Installation Vessel → Site

Other considerations

- Component Load Out: Lifting equipment/methodologies
- Port Haulage: Storage area to quayside transportation

Ports and Harbours

Key Considerations - **Storage requirement/Bearing Capacity**

Component	Parameter	Units[1,2]	Wind Turbine Size [MW]				
			4	5	6	7	8
Wind Turbine	Rotor Diameter	m	120	135	150	164	175
	Blade Length	m	59	66	73	80	85
	Quayside Storage Area (one blade per frame – up to three blades)	m^2	363	440	527	615	696
	Nacelle and Frame Bearing Pressure	t/m^2	7	8	10	7 (3)	8
	Tower Bearing Pressure	t/m^2	6	7	8	9	10
Monopile Foundation	Monopile mass (20 m LAT depth)	t	500	788	1,076	-	-
	Bearing Pressure Under Storage Blocks	t/m^2	13	20	27	-	-
Jacket Foundation	Bearing Pressure Under Storage Blocks	t/m^2	-	13	14	16	17
Substation	Topside Mass	t	500 – 4000 tonnes at approx. 6.5 tonnes per MW				
	Foundation	-	Generally same as for turbines, or jacket if required				
	Bearing Pressure	t/m^2	Typically 2-9 t/m^2, dependent on design				

Bearing capacity: one of critical element in port readiness

Note:
* Gravity Based Foundation: Unlikely to be favoured foundations concept in Taiwan first rounds

Source: GL – "Assessment of ports for Offshore wind development in the US (March 2014)"

Ports and Harbours

Development plans of the Taiwan ports

Taichung Harbour

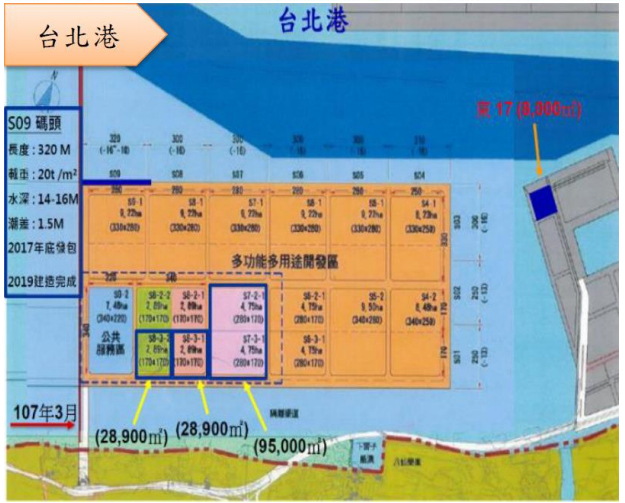
- Offshore wind industrial park in the industry designated zone II and designated O&M port
- Designated WTG component manufacture and assembly zones

Taipei Harbour

- Developing Jacket/Monopile foundation and transition piece manufacture facilities

Kaohsiung Xingda Harbour

- MOEA approved 2017 July = “Kaohsiung Marine Technology Industry Innovation Zone”
- Developing foundation manufacture facilities



Source: TIPC

Ports and Harbours

Gaps and Key Challenges

Federal, State policy-makers *and* ***Port authorities*** *take effective action to strategically plan and support with developing sufficient port infrastructure to meet anticipated project deployment by* ***2025 (5.5GW)***

Vessel Availability

- Port requirement greatly depend on vessel availability
- Limited local vessel capacity

Port Capacity

- Requirement of offshore wind ports more onerous than existing traditional cargo

Manufacture Facilities

- Taiwan early stage expected numerous components delivered from Europe
- Longer transit, requirement to store more components to provide buffer during construction (require larger storage areas)

Limited experience and Funding

- Lack of existing required infrastructures
- Source of funding – and addressing ports typically desire long-term partnership (in order of 10-20years)

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Thank you

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