Development and Business Cooperation of Offshore Wind Power in Taiwan

Taiwan Wind Turbine Industry Association

March 2, 2017
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1. Short Briefing of Taiwan Wind Turbine Industry Association (TWTIA)
Taiwan Wind Turbine Industry Association (TWTIA) was established in 2005 as Taiwan Wind Turbine Industry Alliance under the support of the Industrial Development Bureau (IDB) and Metal Industry Research and Development Center (MIRDC).

It grew into the full-service membership association in Apr 2012, with 62 group memberships, and 12 individual memberships now all over Taiwan.

It’s purpose is to combine personnel from industry, academia and research institutions and personnel together to promote wind power industry development strategy, to provide information and technical exchanges, to actively promote industrial vertical and horizontal integration, and thus to enhance wind-power industry in Taiwan and its ability to compete with the rest of the world.
The Organization of TWTIA

**General Assembly**

**Board of Directors**
- **President**: Wei Chia Min (MIRDC)
- **Standing Member**: Wu Rong Bin (BOLTUN)
- **Director**: Wu Adam (CSBC)
- **Director**: Lin Neng Shi (Swancor)
- **Director**: Zhen Chao Bin (AEC)
- **Director**: Lin Xin Yu (TGC)
- **Director**: Ciou Gu Chuan (FHIC)
- **Standing Member**: Chen I-Cheng (Taipower)
- **Standing Member**: Cheng Qing Zhong (CSMC)
- **Director**: Lai Wen Xiang (Century Iron)
- **Director**: Sun Ge Wei (TECO)
- **Director**: Tsai Shu Ken (YGETG)
- **Director**: Chen Jen Jee (China Ecotek)
- **Director**: Chen KAI Lin (Atech)

**Secretariat**
- **Secretary**: Huang Tseng Wen (MIRDC)
- **Vice Secretary**: Cheng Ming Cheng (China Steel)
- **Vice Secretary**: Chen Fu Ching (MIRDC)
- **Secretary**: Yeh Hsuan Yu
- **Accountant**: Chen Yung Ling (MIRDC)

**Board of Supervisors**
- **Standing Member**: Lin Hui Zheng (NTU)
- **Supervisor**: Wei Li Yi (China Steel)
- **Supervisor**: Yang Ruiuan (NCKU)
- **Supervisor**: Wu Zhao CHENG (SOIC)
- **Supervisor**: Huang Hong Ji (Vestech)

**Small- and Mid-sized Wind Turbine Development Committee**

**Policy and Promotion Committee**

**Industrial Information Committee**

**Technology R&D Committee**
1. Wind Team

CSC launched the Wind Team in 13 September 2016 under the auspices of Taiwan’s Ministry of Economic Affairs’ Industrial Development Bureau. The alliance includes 16 major potential wind turbine component suppliers such as TECO Electric and Machinery Co, Tatung, Boltun Corporation, Fortune Electric, Yeong Guan Energy Technology, Shihlin Electric&Engineering, Formosa Heavy Industries, China Steel Machinery, Delta Electronics, TAYA Group etc. The main goal of the Wind Team is to build up Taiwan local offshore wind turbine supply chain, and bring significant job and economic benefits.

2. Marine Team

A consortium led by shipbuilder CSBC Corp. has launched a strategic alliance on 9 November 2016 and aimed at helping Taiwan reach 520MW of installed offshore wind capacity by 2020 and 3GW of installed capacity by 2025.

The alliance, signed at CSBC Corp, Taiwan, headquarters in Kaohsiung, also includes Taiwan Power Co, China Steel Corp, Chunghwa Telecom Co, the Steel Industries Research and Development Center, the Ship and Ocean Industries R&D Center, the Industrial Technology Research Institute, the CR Classification Society, as well as several local marine engineering companies such as China Steel Express, Taiwan International Ports Corporation, Hung Hua Construction, Hwa Chi Construction, Woen Jinn Harbor Engineering, Taiwan Marine Heavy Industries, CECI Engineering, Asia World Engineering & Construction etc.
2. Current Status and Future Prospects of Wind Power Industry in Taiwan
The Status Quo of Taiwan’s Wind Power

- **Cumulative Installed Capacity:**
  - 28 Wind farm, **329 units**, **647 MW**. (Taiwan Power Company: 293.96 MW, Private enterprise: 352.74 MW)

- **WTG Market Share:**
  - Enercon and Vestas got **62%** and **25%** of Taiwan’s Market Share.

- **Offshore Wind Power Development is at the Very Beginning Stage.**

Source: BOE, MOEA, Taiwan (2016/05)
**Offshore Wind Power Policy Goals**

**VISION**

**Goal**

**Policy**

**Supporting**

- Strengthen energy security
  - Enhance energy independence
  - Promote energy diversity

- Innovate green economy
  - Promote domestic demand to drive employment
  - Innovate, transform & go global

- Promote environmental sustainability
  - Energy saving & carbon reduction
  - Environmental conservation

**Wind power cumulative settings in 2025**

**Land**
- Short-term goal in 2016: 671 MW
- Med-term goal in 2020: 745 MW
- Long-term goal in 2025: 1,200 MW

**Offshore**
- Short-term goal in 2016: 16 MW
- Med-term goal in 2020: 520 MW
- Long-term goal in 2025: 3000 MW

4.2 GW

Initially promote land area settings, build offshore development sustainable environment

- Annual power generation: 14 bln kwh
- Annual carbon reduction: 7.3 mln tons

**Wind power block development**

4-year wind power promotion plan

- MOEA Thousand Land & Sea Wind Turbine Plan Promotion Office
  - One-stop service window, track review progress, remove obstacles

- Executive Yuan Energy & Carbon Reduction Office
  - Assist in cross-ministerial coordination

- Land
  - Social communication
  - Wind field site

- Offshore
  - Energy field site
  - Specialized wharf
  - Industrial park

- Feeder line in parallel
  - Construction fleet
  - Grid-connected substation

- Fishery co-prosperity
  - Regulation enhancement

- Spatial co-competition
Offshore Wind Power Industry Development Strategy

Energy policy goals
Set quantity in 2025 reaches 3GW

Industry promotion goal
Build the independent supply chain in offshore wind power industry

Industry localization development strategy

- Integrate local wind power development teams with local advantages, promote local standards in typhoon and earthquake resistance, connect with international wind power developers for international cooperation.
- Promote international wind power equipment manufacturers to Taiwan for cooperation with market incentives, and establish the supply chain of the industry.

(I) Build infrastructure environment for the development of the industry (Energy Department): Promote domestic large enterprises to take investment in wharf and sea power grid as the objective, promote international benchmark wind power developers to establish cooperative relationship with domestic developers, drive technical cooperation in equipment manufacturing industry (incl. seabed base manufacturing), marine engineering industry and engineering consulting industry, build local technology, and cooperate with big international manufacturers for winning over overseas markets.

(II) Promote industry certification service (BSMI): Build large wind turbine test field and test & certification lab, promote Taiwan’s local standards in typhoon and earthquake resistance and verification capability, drive the localization of offshore wind power industry certification, and enhance the local industry niche.

(III) Promote cross-industrial integration of large enterprises to establish an industrial supply system (Industrial Development Bureau): Promote large utility companies to lead the domestic supply chain to participate in wind turbine localization, such as: nacelle and tower, and assist providers to enter world markets of wind turbines.

(IV) Promote Taipower to build back-end operation maintenance capability (Energy Department): Integrate suppliers of shipbuilding and wind turbine components, build the capability of complete localization of regular operation maintenance components (Industrial Development Bureau) and localization of wind field operation service (Energy Department).

(V) Take the domestic market as the training ground, sell components to overseas markets gradually, cooperate with big international manufacturers, march toward the Asia-Pacific and other international markets (Industrial Development Bureau).
Offshore Wind Power Industry Development Strategy

(1) Vision & goal: Take Taiwan’s wind field as the training ground of industry chain localization, seize offshore wind fields in the Asia-Pacific

<table>
<thead>
<tr>
<th>Industry benefits</th>
<th>Current status</th>
<th>2016</th>
<th>Goal (3GW/600 sets)</th>
<th>2020</th>
<th>2025</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gross output (0.1 b NTD)</td>
<td>80</td>
<td>Cumulative gross output (0.1 b NTD)</td>
<td>1,300</td>
<td>7,000</td>
</tr>
<tr>
<td></td>
<td>No. of the employed (person)</td>
<td>1,400</td>
<td>Cumulative increase in employment (person)</td>
<td>4,640</td>
<td>19,040</td>
</tr>
<tr>
<td></td>
<td>Investment (0.1 b NTD)</td>
<td>20</td>
<td>Cumulative investment (0.1 b NTD)</td>
<td>1,000</td>
<td>4,800</td>
</tr>
</tbody>
</table>

| Development strategy | Short-term | Mid-term | Long-term | |
|----------------------|------------|----------|-----------|
| Integrate the industry chain | Form the industry alliance | |
| Promote private demonstration wind fields to drive peripheral equipment & construction technology investment | Promote Taipower demonstration wind fields to adopt complete sets of domestic facility & ship equipment investment | Use block development to promote domestic industry chain input |

Supporting measures:

- Promote big manufacturers’ investment and assist the industry to introduce complete facility technology
- Use offshore wind power industry alliance to integrate the industry chain
- Guide domestic operators to accelerate the development of key materials and components
- Introduce technology, strengthen manufacturing technology of connected subsystem industry
- Develop parallel power transmission & distribution equipment & intelligent control system
- Promote maritime engineering and shipbuilding industry
- Promote operation & maintenance industry
- Promote industry personnel training
- Use industrial cooperatives to introduce test technology
- Build offshore wind turbine system test labs and standards of typhoon and earthquake resilience

Data source: Industrial Development Bureau Renewable Energy Industry Promotion Plan, Feb 2017
Offshore Wind Power Potential

10 Years Global Wind Speed Rankings

According to statistic data published by 4C offshore, a famous English research organization in offshore energy market, **Taiwan Strait** has 9 great potential of wind farm which belong to Taiwan’s jurisdiction among world Top 18 offshore wind farms.

**Source**: 4C Offshore (Updated: 2016/8/22)
Strategies for Offshore Wind

- **[Phase 1]** Offshore Demonstration Incentive Program (Officially announced on July 3, 2012)
  - 4 Demonstration Turbines by 2016 and 3 Demonstration Wind Farms by 2020
  - Government provides subsidy for both equipment and development processes

- **[Phase 2]** Directions of Zone Application for Planning (Officially announced on July 2, 2015)
  - 36 Zones of Potential revealed for preparation in advance of Zonal Development
  - Applicants must acquire EIA approval by 2017 and Preparation Permits by 2019

- **[Phase 3]** Offshore Zonal Development
  - To be announced by 2017 while SEA is currently in progress
  - Commercial scale for cost reduction
The 3 government sponsored Offshore Wind Farm Demonstration Projects

<table>
<thead>
<tr>
<th>Developer</th>
<th>Location</th>
<th>Distance (km)</th>
<th>Depth (m)</th>
<th>Units</th>
<th>Capacity (MW)</th>
<th>Type of Foundation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuhai (TGC)</td>
<td>Offshore Fangyuan, Changhua</td>
<td>8~12</td>
<td>20~45</td>
<td>30</td>
<td>120</td>
<td>Monopile</td>
</tr>
<tr>
<td>Formosa (Swancor)</td>
<td>Offshore Chunan, Miaoli</td>
<td>2~6</td>
<td>15~35</td>
<td>32</td>
<td>128</td>
<td>Jacket</td>
</tr>
<tr>
<td>Taipower</td>
<td>Offshore Fangyuan, Changhua</td>
<td>7~9</td>
<td>15~25</td>
<td>18~30</td>
<td>108-110</td>
<td>Jacket</td>
</tr>
</tbody>
</table>

Summary : 358 MW

- 4 units are scheduled to be installed by 2016.
- The 3 projects might be accomplished by 2020.

Source : BOE, NEP-Ⅱ (2016/08)
Wind Turbine System & Component supply Chain

- There are more than 20 WTS makers in Taiwan. However, only one company TECO possesses the capability to make large capacity WTS. The barrier to step into Offshore WTS is still high.

- There are also many Large wind turbine component makers in Taiwan. Several of them have become the supplier of global leading firms such as Siemens, GE, Enercon, Gamesa, Vestas.
Potential Offshore WT Component Suppliers in Taiwan

**Blade and materials**
- Atech Composites Co., Ltd.
- Swancor Industry, Co.Ltd (Blade Epoxy)- supplier of Siemens, GE
- Taiwan Glass Industry Corp. (Glass fiber-E class)
- Formosa Plastic Corp. (Carbon fiber)- supplier of Vestas

**Generator**
- Teco Electric & Machinery Corp.

**Cables**
- Sinbon Electronics Co.Ltd. - supplier to Siemens, GE and Some China OEMs
- Hua Eng Wire & Cable Co.Ltd.
- Ta Ya Electric Wire & Cable Co., Ltd.
- Walsin Lihwa Corp.

**EPC**
- China Steel Corporation

**Foundation**
- China Steel Machinery Corp.
- Century Iron And Steel Industrial

**Tower**
- China Steel Machinery Corp.- supplier to Vestas, Gamesa, Enercon, GE

**Inverter**
- Fortune Elec Co., Ltd - supplier of Enercon, GE
- Allis Electric Co., Ltd

**Converter**
- Delta Electronics

**Wind Turbine**
- Synergy (TECO+China Steel)

**Gearbox**
- Formosa Heavy Industries Corp.
- VICTOR TAICHUNG (Yaw gear)
- Great Taiwan Gear

**Castings & Forgings**
- Yeong Guan - supplier to Siemens, Gamesa, Nordex
- Cheng Feng Casting Factory
- Taiwan Cheng Sheng Metal

**Electrical parts**
- Lelon. (Electronic Capacitor)
- Allis Electric Co., Ltd. (Switchgears)

**On and Offshore Logistics**
- CSBC Corporation., Taiwan
- Jong Shyn Shipbuilding Corp
- Hung Hua Construction Co.Ltd
- Hwa Chi Construction Co.Ltd

**Other parts**
- NAK Sealing Tech. (Oil Seal)- supplier to Enercon
- C-Jac Industrial Co., Ltd. (Shock Absorbers)
- Bolton (Bolt) - supplier to Vestas, Gamesa

Source: MIRDC (2016/05)
# Marine Engineering Capability

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>Jack-up Plateform</strong></td>
<td>Honghwa(宏華)-宏禹1號(80m×33m×4.5m)</td>
</tr>
<tr>
<td></td>
<td>Honghwa(宏華)--宏禹號(55.5m×30m×3.6m)</td>
</tr>
<tr>
<td></td>
<td>Hwachi(樺棋)-海岸1號(48m×18m×3m)</td>
</tr>
<tr>
<td><strong>Crane</strong></td>
<td>Chideh(啟德重機械)、Hungtai-Crane(宏泰工程)、I-cheong(宜宗重機械)</td>
</tr>
<tr>
<td><strong>Crane Ship</strong></td>
<td>Woenjinn(穏晉)-(150T)、KL.twport(基隆港務分公司)-(150T)</td>
</tr>
<tr>
<td><strong>Tugboat</strong></td>
<td>Woenjinn(穏晉)-(2,200HP)、Hwachi(樺棋)-(3,200HP)、Honghwa(宏華)-(750HP)、Chausen(昭伸)</td>
</tr>
<tr>
<td><strong>Jack-up Vessel</strong></td>
<td>Woenjinn(穏晉)-(75m×35m)、Hwachi(樺棋)-(75m×26m)、Honghwa(宏華)-(70m×22m)、Chausen(昭伸)</td>
</tr>
<tr>
<td><strong>Floating Pile Driver</strong></td>
<td>Woenjinn(穏晉)、Honghwa(宏華)、Hwachi(樺棋)、Chausen(昭伸)</td>
</tr>
<tr>
<td></td>
<td>、I-san(壹山)</td>
</tr>
<tr>
<td><strong>Support Vessel</strong></td>
<td>Woenjinn(穏晉)、Hwachi(樺棋)、Honghwa(宏華)、Chausen(昭伸)</td>
</tr>
</tbody>
</table>

Great efforts are needed to establish capabilities
Germany-based **InfraVest** will install 367MW wind power located off the coast of Taoyuan.

Denmark-based **Dong Energy**, the world’s biggest offshore wind farm developer, set up a branch office in Taiwan on May 2016 to explore business opportunities in the Asia-Pacific region.

France-based **Eolfi** entered Taiwan in 2014, and would like to install 1GW floating offshore wind power in Taiwan strait.

- InfraVest installed 353.5MW onshore wind power in Taiwan
- Dong Energy is carrying out feasibility evaluation of #13, 14, 15, 16
- Eolfi floating offshore wind concept in Taiwan
## Industrial Cooperation Programs

<table>
<thead>
<tr>
<th>Category</th>
<th>ICP Program</th>
<th>Technology Receiver</th>
<th>Technology Supplier</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Marine Engineering</strong></td>
<td>Wind Turbine Installation Vessel (WTIV) design technology</td>
<td>SOIC/CSBC/CR</td>
<td>IHC(Dutch) ABS(USA)</td>
<td>Implementing Period: 2014/7~2015/9</td>
</tr>
<tr>
<td><strong>O&amp;M</strong></td>
<td>Operation and Maintenance (O&amp;M) Technologies of Offshore Wind Turbines</td>
<td>CSC / MIRDC / SOIC / TOWSC / TPC</td>
<td>ECN(Dutch)</td>
<td>Developing</td>
</tr>
<tr>
<td><strong>Certification Capability</strong></td>
<td>Offshore Wind Farm Development Technology</td>
<td>SOIC</td>
<td>NIRAS(Denmark) TWI(UK)</td>
<td>Implementing Period: 2012/9~2014/12</td>
</tr>
<tr>
<td></td>
<td>Testing and Certification Technology of Offshore Wind Turbine</td>
<td>MIRDC/BSMI</td>
<td>TUV SUD (Germany)</td>
<td>Implementing Period: 2014/8~2016/7</td>
</tr>
</tbody>
</table>

➢ Government provides great helps to foster industrial capability in multiple ways including the technology transfer from global leading companies through the ICP.

Source: IDB, MIRDC(2016/08)
## Construction of Quays for Offshore Wind Farm Installation

<table>
<thead>
<tr>
<th>Year</th>
<th>2016 (Demonstration Turbines)</th>
<th>2019~2020 (Demonstration Wind Farms + Zone of Potential)</th>
<th>2021~2025 (Zonal Development)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cumulative Capacity (MW)</td>
<td>8</td>
<td>520</td>
<td>3,000</td>
</tr>
<tr>
<td>Yearly New Installed (MW)</td>
<td>0</td>
<td>250</td>
<td>500</td>
</tr>
<tr>
<td>Cumulative Turbines (N)</td>
<td>2</td>
<td>104</td>
<td>600</td>
</tr>
<tr>
<td>Quay Requirement</td>
<td>0</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

- **Short term:** Taichung Harbor #5A, #5B is under restructuring to increase its loading capability.

- **Long term:** More quays will be restructured or find another harbor for further development.
3. Conclusion Remarks
1. Taiwan strait possesses abundant **high quality wind resources** due to its unique geographic structure.

2. However, it also encounters with **strong typhoon and earthquake**. The geological formation of **seabed is also weak in weight supporting strength**.

3. The development of offshore wind power in Taiwan strait is consequently a mission of **big challenge and opportunity**.

4. Taiwan’s offshore wind power industry is still at its very beginning stage. We **need great supports from abroad** to overcome all those obstacles in order to **turn the rich nature resource into treasure**.
Thank you for your attention!