



THE OFFSHORE WIND ENERGY SECTOR IN TAIWAN



Flanders Investment & Trade

The Offshore Wind Power Industry in Taiwan

Flanders Investment & Trade
Taipei Office

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2. INTRODUCTION

Taiwan is an island that highly relies on imported energy (97~99%) to sustain the power supply of the country. Nuclear power was one of the solutions to be pursued to resolve the high dependency of the country to fossil-fired power but the government has been facing the public opinion to adjust the energy policy after the Fukushima incident. Since the public's confidence towards nuclear power has been shattered, renewable energy has now become the new hope of the country towards the new low-carbon and less-import-dependency energy portfolio for next decades.

Among the renewables, wind and solar energy are considered to be the first-tier resources to be utilized on the island. Especially offshore wind is regarded as one of the most attractive renewables to be developed since the potential capacity is estimated to be at least 6-10GW in the Taiwan Strait and it has many successful examples in Europe. Thus the Taiwanese government has set the target of 3 GW for wind power by 2025. The attractive potential of offshore wind has given Taiwan a good opportunity to increase the portion of renewable energy in power supply and also to develop the local supply chain by growing it along with on-going offshore wind farm developments.

Chart 1: Taiwan Targets 10GW (15%) Renewable Energy by 2025, of which 3 GW contributed by Wind Energy

Year	2012		2025	
	Capacity (MW)	%	Capacity (MW)	%
RE Renewables				
Hydropower	2,040.7	5.04	2,502	3.72
Wind Power	563.8	1.39	3,000	4.46
Photovoltaic	111.9	0.28	2,500	3.72
Biomass	798.5	1.97	1,400	2.08
Geothermal	--	--	150	0.22
Fuel Cell	--	--	200	0.30
Marine Energy	--	--	200	0.30
Total	3,515	8.68	9,952	14.8

Source: Bureau of Energy, Ministry of Economic Affairs, Taiwan

3. CURRENT ONSHORE WIND POWER IN TAIWAN

Located off the eastern coast of Asia in the Western Pacific, Taiwan has profound wind energy resources. With over six months of northeastern winds every year that sweep across central and western coasts averaging 4 meters per second, or a force 3 wind on the Beaufort Scale that is strong enough to extend flags, Taiwan in fact has inherent advantages for wind power development.. Research by the Industrial Technology Research Institute (ITRI) in Taiwan shows such gentle breeze sweeps around 2,000 square kilometers of the island, most of which across the northern alpine region, western coast and archipelagos off the western coast.

However, Taiwan's onshore wind farms are saturated due to limited land space. Most of onshore wind energy resources had been constructed or planned. Taipower and InfraVest GmbH are the major developers, both of whom use imported wind turbines. Taiwan built the first onshore wind farm in offshore Penghu island early in 2001. According to the Taiwanese Bureau of Energy (BOE), by the end of 2012 Taiwan has 314 onshore wind turbines situated mainly along the western coastline and in outlying Penghu County. The total installed capacity of these land-based turbines is 621 MW, which accounts for 16.6% of all renewable energy. It is planned by the Bureau to build in total 450 units onshore to reach a total capacity of 1,200 MW by 2020. The new units will be able to generate 12.5 billion kilowatt hours of electricity, or 3.3 percent of Taiwan's total power generation. These turbines will double renewable energy to 16 percent of Taiwan's total capacity.

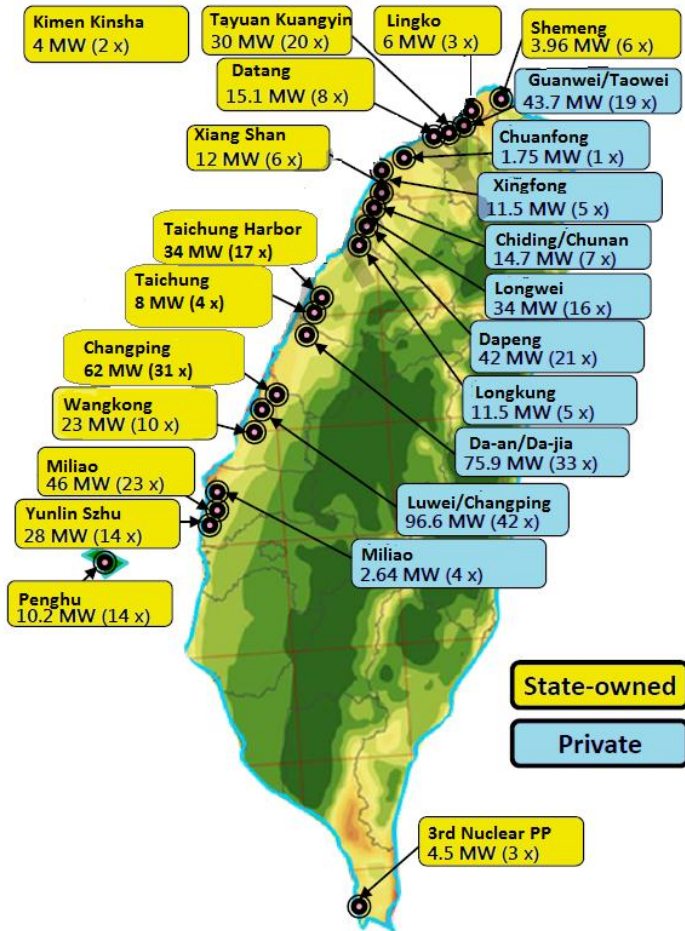


Chart 2: 24 Onshore wind farms in Taiwan, 2012

Source: Bureau of Energy, Ministry of Economic Affairs, Taiwan

● State-owned	161 WTs/287 MW
● Private	153 WTs/334 MW
● Total	314 WTs/621 MW in 2012 (16.6% of all RE)
● Production	About 1,413 MWh in 2012 (13.3% of all RE)

It should be noticed that the average onshore wind farm in Taiwan is only around 20MW mainly due to the limited land space in Taiwan. As a result, the first-tier 24 onshore wind farms are located sparsely island-wide with small-scale wind farm plan.

4. CURRENT OFFSHORE WIND POWER DEVELOPMENT IN TAIWAN

A. OFFSHORE WIND POTENTIAL

In consideration of the facts that onshore wind farm development is almost fully saturated within the island, BOE has decided to further develop the wind farms from onshore to offshore, so as to improve development and utilization of wind energy, and to meet the renewable portfolio target of 2025.

STRONG OFFSHORE WIND

In fact, Taiwan possesses extraordinary advantages in developing offshore wind farms. Offshore winds blow more strongly than those onshore. Taiwan is gifted with excellent wind offshore because of the Taiwan Strait's special geography which causes channeling effect. Thanks to Taiwan's unique coastal terrain, to the east of the Taiwan Strait there's the Central Mountain Range, while to the west there's Fujian Province's Wuyi Mountains. The mountains act like a funnel, channeling the winds, which are very strong. Spacious sea area with strong wind enables the planning of large-scaled offshore wind farms with each installed capacity over a hundred MW, so more clean electricity can be offered for Taiwan use. Thus Taiwan has been recognized and evaluated by the international organization 4C offshore as having the best offshore wind resource in the world.

Chart 3: 10-year Global Wind Speed Rankings by 4C Offshore
(www.4c offshore.com/windfarms/windspeeds.aspx)

Rank	Name	Market	Sea	Speed (m/s)	Observations
1	Pingtian Offshore Wind Farm	China	Taiwan Strait	12.04	6 hr/day/month historic data
2	Changhua – Stage - Taipower	Taiwan	Taiwan Strait	12.02	6 hr/day/month historic data
2	Changhua – Stage III - Taipower	Taiwan	Taiwan Strait	12.02	6 hr/day/month historic data
2	Xidao - TGC	Taiwan	Taiwan Strait	12.02	6 hr/day/month historic data
2	Zhangfang – TGC	Taiwan	Taiwan Strait	11.94	6 hr/day/month historic data
6	Hibao -TGC	Taiwan	Taiwan Strait	11.94	6 hr/day/month historic data
6	Changhua – Stage IV -Taipower	Taiwan	Taiwan Strait	11.94	6 hr/day/month historic data
6	Changhua – Stage V - Taipower	Taiwan	Taiwan Strait	11.94	6 hr/day/month historic data
6	Changhua - Stage VI - Taipower	Taiwan	Taiwan Strait	11.94	6 hr/day/month historic data
6	Changhua- Stage II- Taipower	Taiwan	Taiwan Strait	11.94	6 hr/day/month historic data

HIGH FULL-LOAD HOURS

Strong wind speed also contributes high “full-load hours” for Taiwan to develop offshore wind energy. Full-load hours figures refer to the number of hours per year that the wind speed at a given site is at least 10 meters per second. That is to say, winds are strong enough for the turbine to generate power at full capacity. Turbines on Taiwan's west coast have full-load hours figure that average about 2500 hours, while at Penghu the figure rises to 3,500-4,300 hours, among the highest in the world and far better than the 2,200 hours considered reasonably good for European wind farms.

Though turbines can generate power in winds as little as 3 meter per second, but turbines in such wind condition cannot generate much power. For this reason, to estimate the

quality of a wind farm the industry uses "capacity factor," the ratio of a turbine's actual output at a given location to the amount of power it would produce if it were to run at full load throughout the year. The average capacity factor of Taiwan's wind turbines runs about 29%, behind only those of the UK and Japan. In Germany, by comparison, it is only 17-23%. Even in the summer when Taiwan has little wind, the figure is 20%. In Penghu the figure is much higher, at 40-50%.

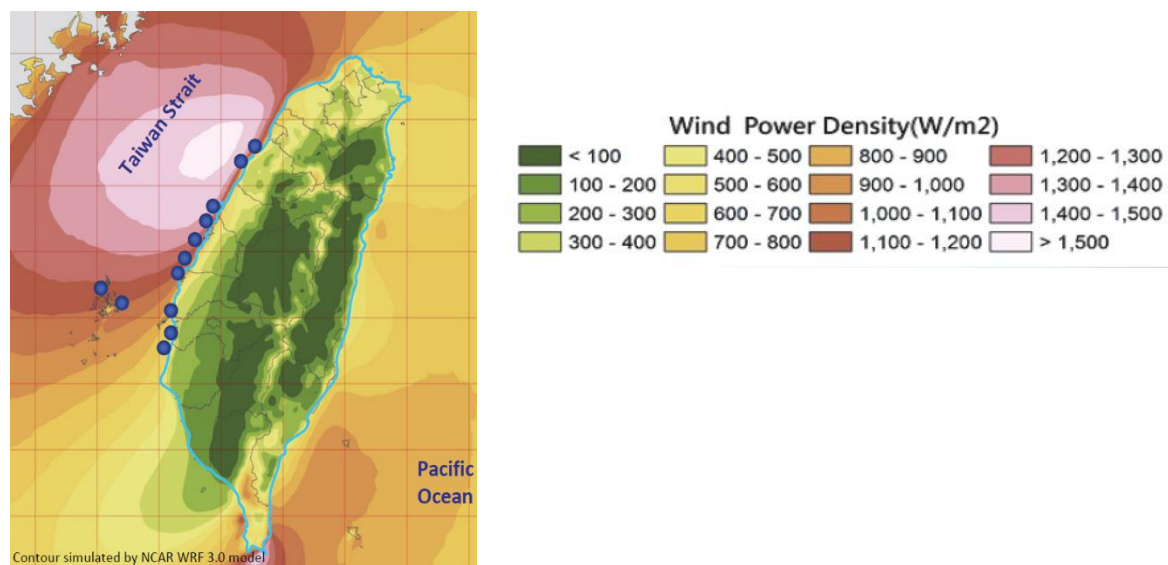
GOOD CONDITIONS FOR BUILDING OFFSHORE WIND FARMS

Furthermore, the conditions for building offshore wind farms in Taiwan are also excellent, approximately 1,200MW can be developed for the water depth from 5~20 meters, and more than 5,000MW can be developed for the water depth from 20~50 meters.

Chart 4: Taiwan Offshore Wind Potential

Source: "Wind Resource Assessment Handbook" ITRI 2011

● Shallow Water (5~20 m)	● Deep Water (20~ 50 m)	● Deeper Water (> 50 m)
➤ Area: 1,779.2 km ²	➤ Area: 6,547 km ²	➤ Potential: 90 GW
➤ Potential: 9 GW	➤ Potential: 48 GW	➤ Feasible: 9 GW
➤ Feasible: 1.2 GW	➤ Feasible: 5 GW	



B. TAIWAN'S TARGETS & EFFORTS FOR DEVELOPING WIND ENERGY

THOUSAND WIND TURBINES PROJECT

The competent government authorities in Taiwan, the Ministry of Economic Affairs, in July 2012 launched the "Thousand Wind Turbines Project" and set targets for Taiwan's wind energy development.

According to the “Thousand Wind Turbines Project”, Taiwan is scheduled to complete the installation of 4~6 offshore wind power pilot projects by 2015. After the first pilot offshore demonstration project is completed in 2015, the government mandated to realize 600 MW offshore wind installation by 2020. Furthermore, by developing more offshore wind farms with larger scale in the deep water, the government plans to install 600 offshore wind turbines with a total capacity of 3,000 MW by 2030. The government’s goal is to have installed wind power capacity account for more than 33% of Taiwan’s total renewable power capacity by 2030.

Chart 5: Government Target for Wind Energy in Taiwan: Thousand Wind Turbines Project

- Short-term Target: 4~6 demonstration offshore wind turbines by 2015.
- Mid-term Target: Offshore 600 MW, total 1,800 MW by 2020.
- Long-term Target: Offshore 3,000 MW, total 4,200 MW by 2030.

Year	2012	2015	2020	2025	2030
Onshore Capacity (MW)	621	866	1,200	1200	1,200
No. Installed Turbines	314	350	450	450	450
Offshore Capacity (MW)	0	15	600	1,800	3,000
No. Installed Turbines	0	4~6	120	360	600
Total Capacity (MW)	621	881	1800	3,000	4,200
Total Installed Turbines	314	354~356	570	810	1,050

Source: Bureau of Energy, Ministry of Economic Affairs, MOEA

DEVELOPMENT POLICIES AND DEMONSTRATION FARMS IN TAIWAN

To realize the targets set by the “Thousand Wind Turbine Project”, the Taiwanese government announced the implementation of "The Offshore Demonstration Incentive Program" in mid 2012. The program was a grant scheme designed to award two offshore wind farm projects owned by two eligible developers. Each winner shall deliver a two-turbine pilot project by 2015 and a 100 ~ 200 MW offshore wind farm by 2020.

The grant is comprised of two parts: the first part is a fixed amount capped at approximately USD \$8 million for the development costs of the 100~200MW wind farm and an offshore met-mast; the second part is a subsidy on 50% of the capital expenditure of the two pilot turbines.

In Jan. 2013, two private companies and the state-owned Taiwan Power Company were awarded the grand scheme to develop Taiwan’s first demonstration offshore wind farms. The two private firms are Taiwan Generations Corporation (alliance led by TGC) and Formosa Wind Power Company (alliance led by Swancor). TGC planned the offshore wind

farm 11 km off the Fang-Yuan coast in Changhua County with 30 wind turbines and a capacity of 108 MW, in water of 25-40m depth. The other winner, Formosa Wind Power, planned the offshore wind farm 5 km off the Chunan coast in Miaoli County with 30 wind turbines and a capacity of 108 MW, in water of 5-30m depth. In the future, 72 units of offshore wind turbines will be installed by separate phases, and the total capacity will approach 260 MW. The state-run Taiwan Power Company also joins the demonstration program with capacity of 108 MW by building 22-36 turbines.

By the end of Dec. 2014, the three developers are required to complete the procedure for getting Establishment Permit. By Sep. 2015, the foundation of offshore wind turbine demonstration units and subsea cable installation must be completed. Before the end of Dec. 2015, grid connection and commercial operation must be completed as scheduled. All 3 offshore demonstration projects will complete 4-6 demonstration units by 2015, and will commission 3 demonstration wind farms by 2020 with a total capacity of 300 MW or more.

The demonstration incentive program is a trial model of large scale offshore wind farm development. In the future, offshore wind farms will be developed in zonal scales with 300 MW per year at deeper water area to gradually reach 3,000 MW with 600 turbines by 2030. Then the total installed capacity of offshore and onshore wind turbines will reach 4,200 MW, and the gross production output will exceed NTD 500 billion (US\$ 16.6 billion). By then, the total installed capacity of wind will consist more than 33% of all renewable energy devices, as expected to be one of the most important alternative energy resources.

Specifications and Requirement of Demonstration Incentive Programs

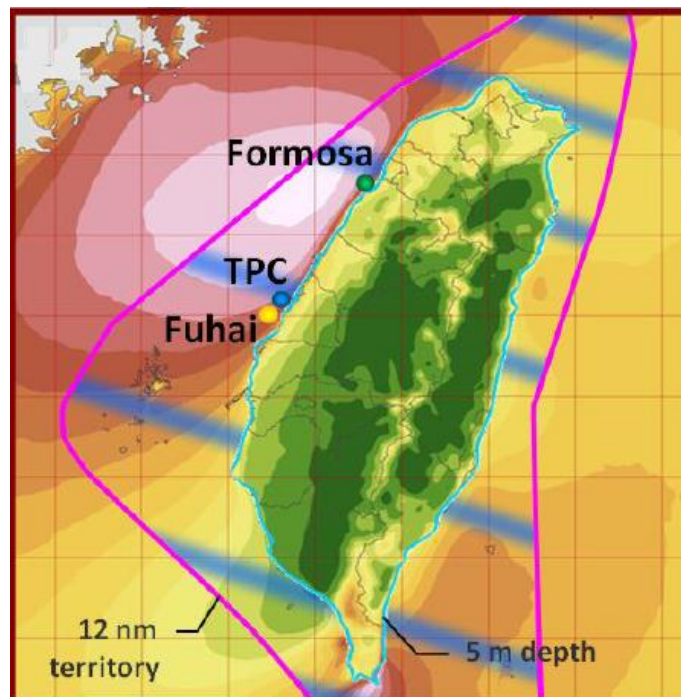
- **Demonstration Turbines**
 - Capacity: at least 3MW each
 - Timing: Commissioned by 2015

- **Met Mast**
 - Water depth: 10 m or more
 - Height: 70 m or more

- **Demonstration Wind Farm**
 - Water depth: 5 m or more
 - Capacity: 100~200 MW each
 - Timing: Commissioned by 2020

SELECTED OFFSHORE DEMONSTRATION WIND FARM DEVELOPERS IN TAIWAN

- 1) **TGC Company** at Changhua
Capacity: 108 MW (30 turbines)
Distance from shore: 11 km
Water depth: 25-40 m
- 2) **Formosa Wind** at Miaoli
Capacity: 108 MW (30 turbines)
Distance from shore: 5 km
Water depth: 5-30 m
- 3) **Taiwan Power Company** at Changhua
Capacity: approximately 108 MW (22-36 turbines)
Distance from shore: 6-8 km
Water depth: 15-25 m



Source: Bureau of Energy, News release 25/03/2013

GOVERNMENT BUY-BACK MECHANISM - FEED-IN TARIFF (FIT)

In terms of the policy, the Renewable Energy Act (REA) promulgated in 2009 supports offshore wind development by providing the developers with a 20-year guaranteed Power Purchase Agreement together with the feed-in-tariff (FIT) mechanism. The Ministry of Economic Affairs invites relevant departments, expert scholars and citizen groups to form a committee to validate and announce the wholesale buy-back price and review it on an

annual basis. Besides, Taiwan is benchmarking to Germany's feed-in tariff system (0/15 cents/kWh). The 2013 and 2014 FiT for electricity generated from offshore wind energy is set at the level of NTD5.5626/kWh and NTD5.6076/kWh (€14.2 cents/kWh) respectively. The government aims to remain at this level before large-scale deployment to enhance future development.

2014 Taiwan Renewable Energy FiT, Taiwan

RE Type	Category	FiT (NT\$/kWh)				
		2011	2012	2013	2014	Change from 2013
Wind	Onshore 1 ~ 10 KW	7.3562	7.3562	7.3562	8.1735	11.11%
	Onshore above 10 KW	2.6138	2.5971	2.6258	2.6338	0.30%
	Offshore	5.5626	5.5626	5.5626	5.6076	0.81%
Hydraelectric		2.1821	2.3302	2.4652	2.5053	1.63%
Geothermal		4.8039	4.8039	4.8039	4.9315	2.66%
Biomass	Without anaerobic digestion	2.1821	2.3302	2.4652	2.5033	1.55%
	With anaerobic digestion	2.1821	2.6995	2.8014	3.2511	16.05%

Compiled from sources: Taiwan Power Company, Bureau of Energy news release 2013/12/21.

CHALLENGES

To further develop Taiwan's ample wind resources, Taiwan still needs to tackle a few issues, including environmental considerations, the threats posed by typhoons and earthquakes, and current limitations in offshore wind generation technologies.

Details of environmental impact assessments (EIA) are yet to be completed. The impacts on migrating birds and ocean mammals, impacts on local fishery, navigation and harbor

development need to be researched beforehand. Otherwise the environment issues will hinder progress, especially when environmental groups are leery of offshore wind turbine construction that impacts marine environments.

Taiwan also lacks suitable subsea construction capability, nor in vessel coordination and construction scheduling. Local builders do not have large pile driving vessels, 500-ton-plus crane vessels and offshore platforms, hence conducting work at 12-meter and deeper underwater is impossible if there is no foreign support. The government is urged to provide financial incentives for Taiwanese companies to strengthen offshore construction capabilities and to purchase needed equipment. Large corporations such as China Steel Corp., Taiwan Shipbuilding Corp., China Steel and Machinery Corp. are actively working with foreign firms and developing such capability.

Bank financing and financial backing from large enterprises are vital to Taiwanese wind turbine builders, especially off shore project are short of precise pre-construction risk assessment and hence are exposed to potentially huge losses during work. Without such financing and investment, potential operators will be discouraged to undermine progress.

C. LOCALIZATION OF SUPPLY CHAIN TO MEET LOCAL ENVIRONMENT NEEDS

Taiwan has natural disasters such as earthquakes and typhoons which do not exist in west Europe. It means that the internationally available technologies cannot be fully applicable or compliant to Taiwan situation. Taiwan needs to cooperate with foreign firms and at the same time develop locally specific technical means suitable for the environments in Taiwan. Efforts are to put the research and manufacturing of key components towards the development of wind turbines and foundations with anti-earthquake, anti-typhoon and anti-corrosion characteristics.

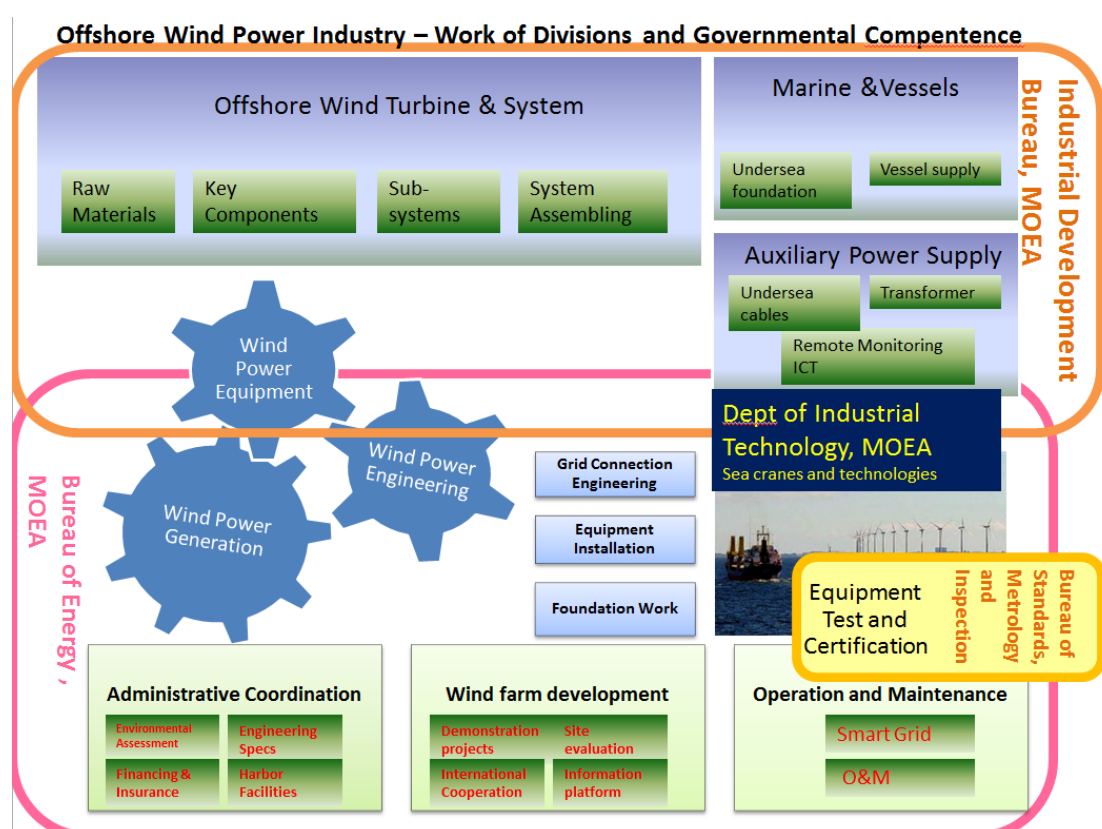
One of the main purposes of the Demonstration Incentive program is to stimulate local industrial development, and to encourage developers to invest on R&D for Taiwan-made turbine components. It also aims to improve local fleets and the abilities of marine construction, operation and maintenance. The industry is encouraged to organize alliances or joint-venture companies with foreign corporations for the co-investment on the development of offshore wind farm. This will assist local component suppliers to connect with international supply chain and create higher value. For example, the four demonstration units constructed by the two private awardees will be provided from overseas. On the other hand, the other demonstration units built by state-run Taiwan Power Company are meant to increase domestic production ratio. "The Offshore Demonstration Incentive Program" aims to bring in substantial investments, but also to facilitate the localization of maritime O&M and domestic supply of key turbine components

5. MAJOR PLAYERS IN TAIWAN

Taiwan has a sound industry base and capability in electrical control and mechanical manufacturing, and relevant industry players are keen to enter the emerging wind power industry. The government is as well keen to promote the manufacturing of wind power equipment and components via the growth of the domestic market. It is necessary to synergy among governmental bodies, R&D institutes and industry insiders, coupled with enhancing technological exchanges with foreign companies. Here below list the key players in Taiwan.

A. GOVERNMENT AGENCIES

The government plays an important role in providing administrative support, subsidies for research, manufacturing and technological breakthrough. In Taiwan, the relevant government agencies and their scope of responsibilities in developing off-shore wind industry are shown in the following chart.



Bureau of Energy, Ministry of Economic Affairs

經濟部能源局 千架海陸風力機計畫推動辦公室

<http://web3.moeaboe.gov.tw> <http://www.moeaboe.gov.tw> <http://www.twtpo.org.tw/>

Address : 13F., No.2, Fusing N. Rd., Zhongshan District, Taipei 10492, Taiwan

Tel +886-2-2772-1370 Fax +886-2-2711-5891 email: energy@moeaboe.gov.tw

The Bureau of Energy (BOE) under the MOEA provides assistance to each demonstration project, especially in coordination works across governmental agencies.

Industrial Development Bureau, MOEA

www.moeaidb.gov.tw

IDB set out policies and guidelines for Taiwan's industrial development including energy policy and offshore wind power industry.

Department of Industrial Technology (DoIT), MOEA

http://www.moea.gov.tw/Mns/doit_e/home/Home1_en.aspx

The main mission of the DoIT is to leverage Taiwan's technology development programs. The agency integrates the R&D resources and soft power of research institutes, academia, and the industry. In addition to jointly developing advanced and cross-domain technologies, DoIT also plays a key role to bridge technology innovation of major IT companies in Taiwan, reinforce the R&D capability of the industry, consolidate Taiwan's strength in applied technologies, speed up industry upgrade, and support new value creation in the industry.

Bureau of Standards, Metrology and Inspections (BSMI), MOEA

www.bsmi.gov.tw

BSMI is the authority responsible for standardization, metrology and product inspection in Taiwan. The activities of the BSMI encompass the development of national standards, the verification of weights and measuring instruments, the inspection of commodities and the provision of other certification or testing services.

B. MAJOR WIND FARM DEVELOPERS

Taiwan Power Company

www.taipower.com.tw

No.242, Sec. 3, Roosevelt Rd., Zhongzheng District, Taipei City 10016, Taiwan

Tel: +886-2-23651234

Taipower is a state-owned company under the Ministry of Economic Affairs. Taipower has completed the installation of 160 onshore wind power units, totaling 284.76 MW, in the first 3 phases and the remote islets wind power projects. All are currently in commercial operation, of which, Changhua Wanggong has 10 units with a total of 23 MW, Linkou 3 units at 6 MW, and Tatan 5 units at 10.6 MW, were completed and started commercial operation in 2011. The Fourth Phase was approved in June 2011 and the implementation period is set to be from 2012 to 2015.

For offshore wind projects, Taipower also joins the government-subsidized demonstration program with capacity of 108 MW by building 22-36 turbines by 2020.

Taiwan Generations Corp.

永傳能源股份有限公司

www.taiwangenerations.com

7F., No.6, Sec. 4, Xinyi Rd., Da'an Dist., Taipei City 106, Taiwan (R.O.C.)

Tel. + 886-2-2705 2555 Fax.+ 886-2-2704 2555

Founded in 1998, Taiwan Generations Corporation (TGC) is a pure-play power project and business development company. TGC has devoted into offshore wind development since 2004, and in the same year erected a 50-meter high semi-offshore met mast, which has been collecting wind data for over 8 years.

Allied with international experienced contractor and local company (Fuhai Corp., CSBC Corp., Century Iron and Steel Company, TGC develop its first offshore win power project, Fuhai Deployment Zone, with 52 wind turbines located off the coast of Fangyuan Township, Changhua County in Taiwan. TGC has also performed feasibility studies including geotechnical survey and oceanographic investigation to make Fuhai Deployment Zone the first offshore wind farm in Taiwan. In 2013, TGC was awarded one of the 3 winners of the Government Grant Scheme and is the first developer receiving the Environmental Impact Assessment approval for offshore wind project in Taiwan with the scope of Changhua Offshore Pilot Project (“COPP”, 2 turbines) and Fuhai Offshore Windfarm (28 turbines). Following the schedule of the Government Grant Scheme, TGC aims to realize COPP before the end of 2015 and Fuhai Offshore Windfarm before the end of 2020.

Formosa Wind Power Company

海洋風力發電股份有限公司

www.swancor.com.tw

No. 9, Industrial South 6th Road, Nankung Industrial Zone, Nantou City

TEL : +866 49 2255420 FAX : +866 49 2251534

E-mail: swancor@swancor.com.tw

Formosa Wind Power Company was one of the 3 awardees of the government’s grant scheme for demonstration offshore wind farms in Taiwan. It is an alliance lead by Swancor Corp. a public listed company in Taiwan, with partners from members of Taiwan Offshore Wind Energy Alliance. Swancor starts as a major manufacturer and supplier of Mega Watt (MW) wind blade Resin. It moves from upstream manufacturing supplier to wind power project developer. Formosa Wind Power has planned the offshore wind farm 5 km off the Chunan coast in Miaoli County with 30 wind turbines with a capacity of 108 MW, in water of 5-30m depth. In the future, 72 units of offshore wind turbines will be installed by separate phases, and the total capacity will approach 260 MW.

C. MAJOR R&D INSTITUTES, INDUSTRIAL ASSOCIATIONS AND COMPANIES

The Green Energy and Environment Research Laboratories, ITRI

<http://www.itri.org.tw>

<http://wind.itri.org.tw>

<https://www.itri.org.tw/eng/econtent/research/research05.aspx>

Address: 195, Sec. 4, Chung Hsing Rd., Chutung, Hsinchu, Taiwan 31040

Tel: 886-3-591-2251 E-mail : szuhan@itri.org.tw

工業技術研究院 綠能與環境研究所 (風力資訊整合平台)

ITRI was assigned and funded by the government to carry out a three-year research on Taiwan’s offshore wind power potential and requirements. The research also included site selection, environmental impact assessments and preliminary design evaluation. The laboratories in 2006 installed a 60m-high wind speed observatory tower for data acquisition

and processing system in Chiayi coast to collect national wind energy data. It also deployed a wave device near Keelung Harbor. ITRI cooperated with various offshore wind power expert teams and has built a significant portfolio of external collaborations in the renewable energy sector, many building on Taiwan's expertise in the PV technology sector.

Taiwan Wind Energy Association

台灣風能協會

<http://www.twnwea.org.tw/>

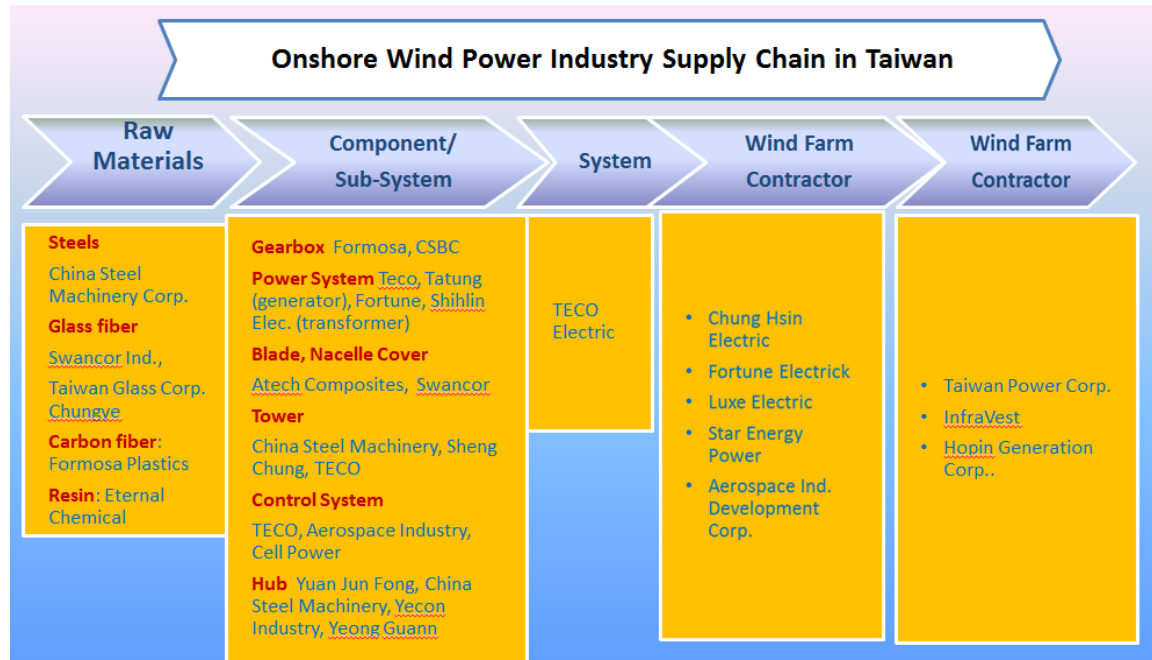
24 Bldg, No.195, Sec. 4 Chung Hsing Rd., Chu Tung, Hsin Chu 31040, Taiwan

Tel +886-3-5914213 Fax +886-3-5820017

General contact : Ms. Huang E-mail : TwnWEA@twnwea.org.tw

The association was formed by the **Mechanical and Systems Research Laboratories** (<https://www.itri.org.tw/eng/econtent/research/research06.aspx>) of Industrial Technology Research Institute of Taiwan (ITRI) in Jan. 2006. The Association's main task is to develop wind-energy technologies in Taiwan. It also aims for experts and engineers at home and abroad to build a cooperation platform to promote wind power, technology and information exchange.

Members are key players in the onshore wind power industry supply chain. Production items include generators, trnsformers, towers, power converter modules, the components for the above-mentioned items and also small and medium wind turbines. Most member companies have also involved into offshore wind power supply chain. Detail contact info can be obtained from member list: <http://www.twnwea.org.tw/Association.aspx>



Info compiled from source: Industrial Development Bureau, Metal Industry Development and Research Center

Taiwan Wind Turbine Industry Association (TWTIA)

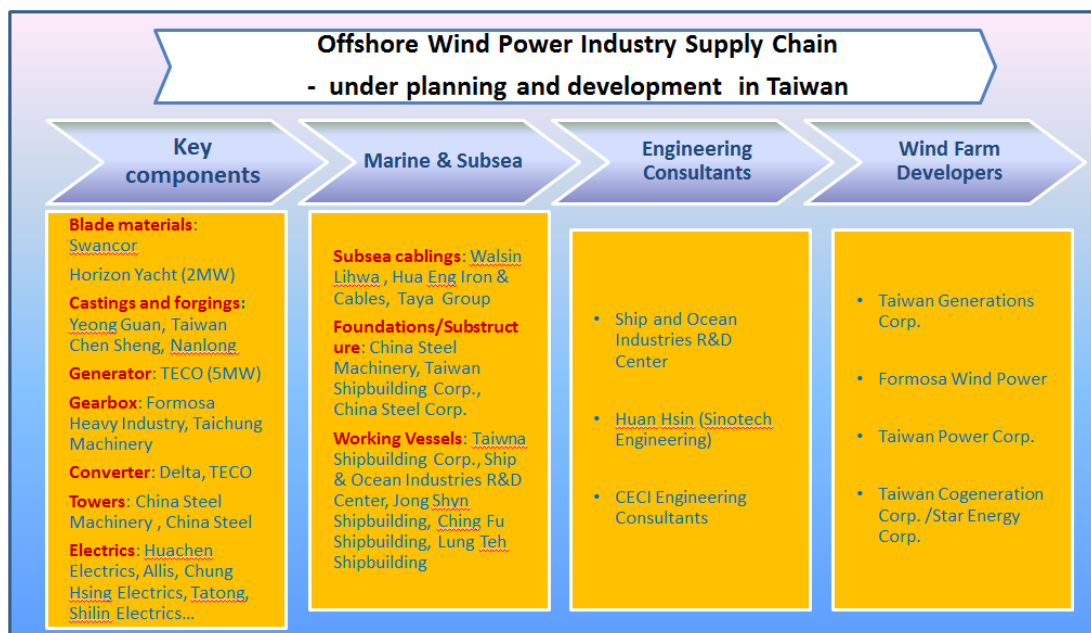
<http://www.twtia.org.tw>

C/O: Metal Industries Research Development Center

<http://www.mirdc.org.tw/English/index.aspx>

Contact: Chu Hua Lin Email: hua@twtia.org.tw
 Tel +886-7-351-3121 ext.3131 Fax +886-7- 353-1708

Taiwan Wind Turbine Industry Association (TWTIA) was established to integrate the industry, academia and research institutions and personnel together to develop the local wind power industry supply chain. The association also found the **Taiwan Offshore Wind Energy Alliance** composed of 18 private firms from the electro-mechanical, plastics and chemical, parts and components, and maritime engineering sectors. The leading members of the alliance include the above-mentioned Taiwan Generation Corp., Swancor Corp. and leading companies such as China Steel Machinery Corp., Formosa Heavy Industries Corp., Red Blades Windtek Corp., Yuan Chuan Energy Corp., Taiwan Cogeneration Corp., Fortune Electric Co., Allis Electric Corp., CSBC Corp., Taiwan, and Yeong Guan Energy Technology Group. The 18 members boast market capitalization exceeding NT\$200 billion and pledge to create Taiwan's pilot offshore wind farm by tapping cross-industry partnership. Besides, members are committed to developing locally specific technical means suitable for the environments in Taiwan. Though today Taiwan is still very far from establishing a comprehensive supply chain, efforts are to put the research and manufacturing of key components, wind turbines and foundations with anti-earthquake, anti-typhoon and anti-corrosion characteristics.



Construction Financing Institutes: First Commercial Bank, Fubon Insurance, China Industrial Development Bank, Export-Import Bank of ROC, King's Town Bank

Contractors and O&M Engineering Service Providers: Hwa Chi Construction Co., Ltd., Hung Hua Construction Co., Ltd., Woen Jinn Harbor Engineering Co. Ltd., Chau Sen Co., Ltd. China Steel Express Corp., Giant Project Service Corp.

Info compiled from source: Industrial Development Bureau, Metal Industry Development and Research Center

China Steel Corp.

www.csc.com.tw

Add: No. 1, China Steel Road, Hsiao-Kung District, Kaohsiung 81233, Taiwan

Attn: Engineering Division

Tel +886-7-8021111 Fax +886-7-8039823

The Engineering Division of China Steel plays an important role in developing Taiwan's foundations/substructure work for offshore wind power projects. The company will invest 100% to set up a wind power development company.

Besides, CSC in July 2013 signed an agreement with Port of Taichung to plan and supervise the establishment of an "Offshore Wind Industry Assembly Harbor and Industrial Park." The Port of Taichung in the agreement provides CSC with No. 2 pier and 74.28 hectares of land. CSC will use this land to create a wind power industrial cluster, including a testing and certification facility, drawing six related manufacturers to the zone and more in the future to benefit from a clustering effect.

Siemens Limited Taiwan

www.siemens.com.tw

Add: 8F, No. 3, Park Street, Nangang District, Taipei 11503, Taiwan

General phone +886-2-2652 8888 Fax +886-2-2652 8777

Siemens is the world's biggest off-shore wind turbine solution provider and has helped install farms with capacity totaling 1,600 megawatts in the UK, Germany and the US. Siemens Taiwan will collaborate with Formosa Wind Power Co Ltd. and Taiwan Generations Corp. to build Taiwan's first offshore wind farms.

Teco Electric and Machinery Co. Ltd.

www.teco.com.tw

Add: 5F, No. 19-9, San Chong Road, Nangung District, Taipei 11560, Taiwan

General phone +886-2-2655 3333 Fax+ 886-2-2655 1548

Teco develops Taiwan's first domestically-made 2MW permanent-magnet synchronous wind turbine motor. The company is regarded as the pioneer that activates the wind turbine motor supply chain in Taiwan.

6. INTERACTION BETWEEN BELGIUM AND TAIWAN

Taiwan has a sound industry base and capability to develop key components and sub-systems for the industry. However, offshore wind power industry is an integrated one with wide lateral connectivity and cross-industry collaboration. It covers materials, electrical motors, machinery, electronics and metals, construction work, maintenance, port operation and also working vessels and logistics. Taiwan lacks capability in system integration and wind turbines will all depend on imports. Taiwan also lacks suitable subsea construction capability, nor in vessel coordination and construction scheduling. Existing local ship builders do not have large pile driving vessels, 500-ton-plus crane vessels and offshore platforms. Besides, Taiwan urgently seek technologies from abroad for sub-sea cabling production and installation, and for the design and construction of offshore sub-stations.

The Belgian authorities have appointed area for offshore wind farm early in 2004. Belgium prides to have the deepest and furthest offshore wind farms into operation in year 2013, with 603 MW energy needs for 460,000 families, and the largest wind turbine (6MW). Belgium has expert companies with long experience in marine engineering. Belgium can provide experiences of offshore wind farm development in the aspects of marine and sub-sea engineering, onshore infrastructure, project finance & insurance, environmental impact assessment solutions, wind farm port logistics and facilities, etc. The interactions can proceed in the form of joint research programs, industrial cooperation mechanism, technology transfer and commercial projects.

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