Offshore Wind Power Development in Japan

2 March 2017
Japan Wind Power Association (JWPA)
http://jwpa.jp

Dear TWTIA Mission,

Offshore Wind Power Experience in Japan (2016)

Setana
2003
Vestas
600kW X 2units

Akita, 2015
Siemens 3MW

Sakata, 2004
Vestas
2MW X 5units

Hibikinada
2013
JSW 2MW

Choshi
Jan 2013
MHI 2.4MW

Fukushima FORWARD
2013 Hitachi 2MW
2016 MHI 7MW
2017 Hitachi 5MW
(Floating)

Kamisu
2010 FHI 2MW X 7units
2013 Hitachi 2MW X 8units

Setana
2003
Vestas
600kW X 2units

Hibikinada
2013
JSW 2MW

Setana
2003
Vestas
600kW X 2units

Hibikinada
2013
JSW 2MW

Sasebo, 2009
1/10 Model
(Floating)

Kabashima
at Goto Islands
2012~14 FHI 100kW
2013-16 Hitachi 2MW
(Floating)

Relocated to
Fukuejima
2016
Hitachi 2MW
(Floating)

Sakata, 2004
Vestas
2MW X 5units

Hibikinada
2013
JSW 2MW

Choshi
Jan 2013
MHI 2.4MW

Fukuejima
2016
Hitachi 2MW
(Floating)

Saga, (2013,failed)
500kW Model
(Floating)

Hibikinada
2013
JSW 2MW

Sasebo, 2009
1/10 Model
(Floating)

Kabashima
at Goto Islands
2012~14 FHI 100kW
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Sakata, 2004
Vestas
2MW X 5units

Hibikinada
2013
JSW 2MW

Choshi
Jan 2013
MHI 2.4MW

Fukuejima
2016
Hitachi 2MW
(Floating)

Saga, (2013,failed)
500kW Model
(Floating)

Black: Early exam.
Green: Fixed type
Brown: Floating(small)
Blue: Floating type
**: National Project

Note: FHI’s WTG division has merged by Hitachi in July 2012.
Offshore Wind Power Experience in Japan (2016)

- 59.6 MW, 28 turbines, 9 projects at 8 locations in total at the end of Feb. 2017. It is 1.8% of total wind power installation (3,234 MW) in Japan.

- 44.2 MW, 23 turbines (74%) are commercial or local government owned projects. Almost all of them are very close to seashore, so-called “Semi-offshore”. Dolphin type or Monopile type foundations are used at these projects.

- Real offshore projects (more than 1 km from seashore) are National projects.
  Fixed type by NEDO: 4.4 MM, 2 turbines at Choshi and at Kitakyusyu (Gravity type) (Jacket type foundation)
  Floating type by MOE: 2 MW, 1 turbine at Kabashima (Spar type floater) (GOTO–FOWT) → It granted to Goto city, relocated 10 km southeast to Fukue island, reconnected to grid, and started commercial operation in Apr. 2016.
  Floating type by METI: 9 MW, 2 turbines at Fukushima (Semi-sub type floater) (Fukushima FORWARD, on going) → 5 MW turbine on advanced spar type floater was anchored in 2016 and it starts official operation in Mar. 2017.

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<thead>
<tr>
<th>Type</th>
<th>Location</th>
<th>Distance (km)</th>
<th>Depth (m)</th>
<th>Rated (MW)</th>
<th>No. of WTG</th>
<th>Total (MW)</th>
<th>Start operation</th>
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<td>Total</td>
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<td>59.6</td>
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*National projects () : Relocated, Under commissioning
Offshore projects by Local governments and private companies

Dec. 2003
At Setana port in Hokkaido
By Local government (Setana)
700m offshore, 3m in depth
Vestas 600kW x 2 turbines
Dolphin type foundation
1st offshore wind power in Japan

Feb. 2010 at Kamisu in Ibaragi
By Wind Power Group
Offshore from 40~50m, 4m in depth
FHI (Hitachi) 2MW x 7 turbines
Monopile foundation ($3m)
They withstood huge Tsunami in 2011.

Demonstration of Offshore Wind Power Generation by NEDO, at Choshi, Chiba Pref.

WTG: MWT92/2.4 offshore model
Foundation: Gravity type
Output: 2.4MW
Rotor Dia.: 92m
Hub Ht.: 80m
Water Depth: 12m
3km from seashore

Ref: NEDO (New Energy and Industrial Technology Development Organization)
Demonstration of Offshore Wind Power Generation by NEDO, at Hibikinada, Fukuoka Pref.

- JSW J82 2MW gearless PMSG WTG
- Switching Gear
- Under sea cable
- Anemometer Tower
- WTG
- Hybrid Gravity Foundation

Ref: NEDO

JSW J82 2MW gearless PMSG WTG

In Operation on June 2013.

Ref: NEDO

MOE Floating WTG Project at Kabashima in Goto Islands, Nagasaki Pref. (GOTO-FOWT)

Hitachi’s Down wind type 2MW wind turbine

28 Oct. 2013: in Operation
2MW floating turbine was relocated in 2016

MOE’s national project has finished in Mar. 2016. The turbine was granted from MOE to Goto city local government. Toda Co. has moved WTG about 10km southwest from Kabashima to Fukuejima. Fukuejima has more population (38k) and larger electricity capacity than Kabashima. It was re-connected to the gridline and started commercial operation in Apr. 2016. METI approved offshore wind tariff 36JPY/kWh for it. (1st and only case in Japan)


METI’s Fukushima Recovery, Experimental Offshore Floating Wind Farm Project (FukushimaFORWARD)

Project Consortium: 11 members
Marubeni (Project integrator)  MHI
University of Tokyo  Mitsubishi Corp.
IHI Marine United  MES
Nippon Steel  Hitachi
Furukawa Electric  Shimizu Corp.
Mizuho Information & Research

Source: Fukushima offshore wind consortium
Floating substation (Hitachi) on advanced spar type floater (JMU), since 2013

1st 2MW turbine (Hitachi downwind type) on semi-sub type floater (Mitsui Zosen), since 2013

2nd 7MW turbine (Mitsubishi hydraulic type) on semi-sub type floater (Mitsubishi), since 2016

3rd floating turbine
- 5MW turbine (Hitachi, downwind type) is ready for shipping.
- Advanced spar type floater is under construction at dockyard in Osaka.
- The turbine was installed on the floater at Osaka bay and carried to Fukushima in 2016.

5MW Floating Wind Turbine for Fukushima Project has been completed at Osaka on 24 May 2016.

April, 2016, at Sakai Dockyard of HITZ

On 2 May at Osaka bay Sumoto port

On 9 May

On 14 May

On 18 May

On 19 May

On 24 May

The floater has leaned temporarily. But, it was recovered within 5 days.
Coming Offshore Wind Power Projects in Japan (2016)

- 1926 MW, 18 projects at 13 locations in total now. Most of them are under EIA procedure.
- 1406 MW, 13 projects are commercial projects. The earliest one shall be “Kashima port 1st”.
- 5MW floating turbine is added at Fukushima in 2017
- 3–4 MW floating turbine shall be added at Kitakyushu in 2018 by NEDO new project
- Japanese Government (MOE) settled two offshore Test fields

Legal Hurdles:
- Port associated area: Cleared in 2016
- General common area: Start discussion in 2016

### Coming Offshore Wind Power Projects in Japan (2016)

<table>
<thead>
<tr>
<th>Type</th>
<th>Location</th>
<th>Port</th>
<th>WTG (MW)</th>
<th>No.of WTGs</th>
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*National projects
**Estimated by JWPA
*** 3GW is offered at Akita far offshore by NGO, besides this table
Roadmap for the Wind Power Introduction for Japan, proposed by the JWPA

• 10GW prospect at Energy mix plan shall be achieved at early 2020s.
  (3.2GW at 2016 + 10.8GW during EIA process = 14GW)
• JWPA proposes 36.2GW toward 2030 for the next stage.

Japan has Huge Wind Energy Resources

Onshore: ave. wind speed 6.5m/s considering social acceptance
Offshore: ave. wind speed 7m/s
Distance 30km
Sea depth 200m considering social acceptance
Hurdles against offshore wind in Japan

- Small official target by Japanese government (820MW).
- Restricted shallow sea area (surrounded by deep sea)
- Floating wind power for deep sea by national projects were very expensive.
- Poor grid infrastructure at good wind area (Hokkaido & Tohoku, northern Japan)
- Moderate wind speed (Low income) at offshore area in central & western Japan
- Big law uncertainty at “General common sea area” (So-called Thomas Hobbes’s “the war of all against all”. “Who has the permission rights?” is not clear now. Concerning Fishermen’s rights, Decommissioning, etc.)
- Small law uncertainty at “Port associated area” (Permission term is 20 years. We need extension procedure)
- Lack of “Jack up ships/SEP”, “Base ports”
- “Cabotage / Labor restriction” for Jack up ships
- Long EIA process (4-5 years)

Jack-up ship problem can be solved in Japan

Penta-Ocean Orders First Japanese-Built Wind Turbine Installation Vessel

Penta-Ocean Construction and Japan Marine United Corporation (JMU) have signed a contract for the construction of one multi-purpose self-elevating platform vessel suitable for marine civil engineering works or offshore wind turbine installation in harsher weather and marine conditions.

The basic design of the jack-up vessel, the first of its kind to be built in Japan, has been supervised by the Netherlands-based GustoMSC.

The vessel is designed based on jack-ups used in Europe for installation of oil rigs or offshore wind turbines, but with a jack-up system that matches Japanese natural conditions and on-site characteristics.

It will be equipped with a fully-revolving crane with an 800-ton lifting capacity, as well as a dynamic positioning system, enabling the vessel to perform installation of large-scale marine structures such as offshore wind turbines with a capacity of up to 6MW and foundations in the water depths of up to 50 metres.

The jack-up is also designed for operations in Japan’s Greater Coasting Area and for becoming a shallower draft vessel. It will come equipped with accommodation units and a helicopter deck for emergency transfers.

The jack-up is expected to be delivered in September 2018.

As a result of latest amendment to the country's Port and Harbor Act that took effect on July 1, 2016, the port areas will be more accessible to operators wishing to construct offshore wind farms, and the vessel is optimized to undertake this task, according to Penta-Ocean.
Japanese trade company Marubeni retired from Kashima port2 offshore project due to low profitability with low wind speed. (SBEnergy/Softbank retired from neighbor port1 project. Local developer Komatsuzaki group continues it.)

Marubeni cancels part of port-based project

13 January 2017 by Martin Foster, Be the first to comment

JAPAN: The Marubeni Corporation has informed the Ibaraki prefectural government it will stop developing a wind project planned for a site in Kashima port.

Marubeni said it would discontinue the project based on estimates that the wind power was not strong enough to meet targets.

The Ibaraki prefectural government said Marubeni had scrutinised profitability throughout the development period and found it fell below acceptable levels, making it difficult to approve an investment decision.

Marubeni was originally selected to develop the southern part of the port area in August 2012.

Another developer, Windpower Energy Group, won the bidding for the southern portion of the port area and will reportedly continue with the project.

The prefectural government will reopen bidding for Marubeni's portion of the port project in February.

In August 2016, Marubeni signed an agreement with a consortium of companies, including utilities, to carry out feasibility studies for two proposed projects at two port sites in the Akita prefecture, in the northern part of the major Japanese island, Honshu.

"Port and Harbor Law" has been amended to promote offshore wind power development in Japan on 13 May.

Japanese Ministry of Land, Infrastructure, Transport and Tourism (MILT) intends to promote offshore wind power development and modifies "Port and Harbor Law" modification. This modification proposal is approved by the House of Representatives and the House of Councilors in Japan on 13 May 2016. This modification is bundled with the promotion of port abilities for sightseeing cruises.

The new contents are as follows:
- To allow 20 years occupation of the designated water zone in the port area for developers
- To settle the bidding system of offshore wind power development in the port area

20 years is too short for the full business period (from research, construction to decommission). It is adopted as a compromise, since there are no experience for fixed term more than 20 years in Japanese law system. Developers can offer the occupation rights again. Therefore this restriction will not harm the projects.

Port area has a good infrastructure for construction and grid connection. Therefore, most of offshore wind power projects are planned in port area in Japan now.

MILT organizes specialists committee to settle the detail rules. The first meeting is to be held on 19 May.

Japanese News for GWEC, reported by JWPA
You can see them at JWPA's Web site http://jwpa.jp/index_e.html
Japanese MILT amended “Port and harbor law” to promote offshore wind power at Port associated area in May 2016

The contents of amendment make it clear;

- “How to bid for the offshore wind power” at port associated area. (including how to expand “port associated area”)
- The concrete contents for the bidding/auctions (including decommission at the end of the projects)
- The winners get “20 years occupation permission”. (It’s too short for “from planning to decommissioning”. We have to request permit extension during project lifetime.)

Offshore Wind Project at Kitakyusyu port
Kitakyushu city Gov. has large interest for “Contribution for local economy & job”. They dislike “Wimbledon Effect” like UK’s Able port met this summer.
Local Industry Group (Kyushu Electric Power, J Power, etc.) won the Kitakyushu bidding in Feb. 2017

Sited off the coast of Fukuoka prefecture on the western island of Kyushu, construction of the Hibikinada wind farm would start in 2022 following an environmental impact assessment expected to take three to four years to complete, the Hibiki Wind Energy group, which includes utility J Power, Saibu Gas and engineering firm Kyudenko, said in an online statement.

The wind farm would be built around as many as 44 turbines installed on jacket foundations roughly 10km off the port of Hibikinada, in Kitakyushu’s Wakanatsu Ward. The project will span 2,700 hectares across four adjacent sites, where wind speeds average about 7 metres per second.

The Kitakyushu government said that the project will necessitate upgrades to Hibikinada’s port infrastructure.

In addition, Hokutaka will likely establish an O&M base near the port, while NSSMC will set up a foundation production facility.

The consortium might also spearhead the construction of a gearbox production base, the local government said.

The auction for the Hibikinada project is the first public offering of near-shore development rights since the Port and Harbour Law was revised last May. The amendments have given project owners the right to operate wind farms in ports beyond the original occupancy limit of 10 years.

The Kitakyushu Seaport and Airport Bureau opened up bidding for the Hibikinada project in August, with an initial plan of at least 50MW.

The municipal authorities have already overseen the construction of several pilot projects near the Hibikinada port, most notably with the 2013 installation of a 3MW Japan Steel Works turbine on a four-legged, trussed steel jacket foundation in 15 metres of water.

The Ministry of Environment also launched a study in early 2015 to assess the feasibility of building a 700MW, fixed-foundation project off Hibikinada.

The island of Kyushu is rapidly emerging as a potential hub for offshore wind. In early 2016, the UK Carbon Trust announced plans to set up a tidal and floating wind energy test facility with the authorities in Nagasaki prefecture.

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Consortium picked to build Japan’s largest offshore wind farm

A consortium led by regional Japanese utility Kyuden Mirai, has been chosen to develop what would be the Asian country’s largest offshore wind farm to-date, a ¥17.5bn ($1.3bn) project expected to add 225MW to the current fleet.

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Akita North Offshore Wind Project by Obayashi Co.

5MW x 91 units = 455 MW
Offshore Wind Project Plan at Akita (3GW)

風の王国が中心となって、秋田県の能代市から秋田市の海域で洋上風力発電の構想を策定している（設備容量：約300万kW）。

7MW×426基 = 約300万kW

6ブロック426基をレイアウト済み

年間予測発電量 9720.5GWh

ブレード直径 160m
タワー直径 10m
ナセル重量 400t

課題は系統連携/送電線の整備

Offshore Wind Model Planning Projects by MOE

平成27年度風力発電等に係る地域主導型の戦略的適地抽出手法の構築モデル事業について 予算：158百万円（新規）

⇒ 事業リスクの軽減と早期環境配慮の両立
⇒ 再生可能エネルギー供給拠点の創出促進
⇒ 戦略的環境アセス（SEA）の具体的事例の形成

※ 岩手県
洋野町

※ 鳥取県

※ 長崎県五島市

五島市崎山町・五島沖
洋上（浮体式）
22,000 kW
500,000 kW

東伯郡北栄町
陸上 50,000 kW

洋野町沖合海域
洋上（着床式）
200,000 kW

北九州市若松区營瀬沖
洋上（着床式）
200,000 kW
500,000 kW

出典 環境省：中央環境審議会・総合政策部会 環境影響評価制度小委員会（第2回）資料
Wind Turbine Industry/Supply Chain in Japan

- Japan has turned to pro-renewable energies including wind power after the Fukushima accident in Mar. 2011.

- 3 industrial associations (JSIM, JEMA & JWPA) have jointly started collecting and reporting production statistics regarding wind turbines & their components made in Japan since FY2009. (FY: Fiscal year, from April to next March)

- This presentation is the outline of the reports for FY2009–FY2014.

Our latest report published in May 2016

Research Committee Organization (in FY2014)

<table>
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<tr>
<th>Chairman</th>
<th>Prof. Takao Maeda, Mie University, JWEA</th>
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<td>Secretary</td>
<td>JSIM and JWPA</td>
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<td>Board Members:</td>
<td>WTG Manufacturers; 2</td>
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<td>Components &amp; Material Manufacturers; 3</td>
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<td>Hitachi Co. Ltd.</td>
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<td>Fuji Electric Co. (Electric devices)</td>
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<td>NTN (Bearing)</td>
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<td>ISHIBASHI (Gearbox)</td>
</tr>
<tr>
<td>The Japan Society of Industrial Machinery Manufacturers (JSIM)</td>
</tr>
<tr>
<td>The Japan Electrical Manufacturers’ Association (JEMA), The Japan Wind Power Association (JWPA)</td>
</tr>
<tr>
<td>Yasukawa Electric Co. (Generator &amp; Electric devices)</td>
</tr>
<tr>
<td>Meidensha Co. (Generators &amp; Electric devices)</td>
</tr>
<tr>
<td>Jtekt (Bearing)</td>
</tr>
<tr>
<td>NSK (Bearings)</td>
</tr>
<tr>
<td>Sumitomo Heavy Industries, Ltd. (Gearbox &amp; Yaw devices)</td>
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<tr>
<td>GH Craft (Blade)</td>
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<td>The Japan Bearing Industry Association (JBIA)</td>
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<tr>
<td>The Shipbuilders’ Association of Japan (SAJ)</td>
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<tr>
<td>Japan Fluid Power Association (JFPA)</td>
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</tbody>
</table>
3 large WTG manufacturers in Japan

- Mitsubishi Heavy Industries (MHI)
  2.4 MW, geared

- Hitachi Co.
  2MW, downwind, geared

- Japan Steel Works (JSW)
  2.7MW, gearless PMSG

Japanese Companies relating WTG supply Chain
Research Result: Factory Location of Wind Turbine Industries in Japan

Factory Location

Employer Distribution

Research Result of “Total Sales” in FY2014

(103,585 million JPY)
(0.91 bil.€/1.03 bil.$)
**Trend of the Large Bearing Sales**

for FY2009–FY2014

- NSK
- Jtekt
- NTN

**Stable business. Almost all bearings are exported.**

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<thead>
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<tbody>
<tr>
<td>Overseas Production</td>
<td>0</td>
<td>0</td>
<td>0.01</td>
<td>0.12</td>
<td>0.12</td>
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<tr>
<td>Domestic Sales</td>
<td>5.59</td>
<td>0.614</td>
<td>0.609</td>
<td>0.669</td>
<td>1.167</td>
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<tr>
<td>Domestic Production</td>
<td>20.68</td>
<td>15.9</td>
<td>14.2</td>
<td>11.118</td>
<td>15.59</td>
<td>16.982</td>
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<td>Total Production</td>
<td>20.68</td>
<td>15.9</td>
<td>14.21</td>
<td>11.238</td>
<td>15.71</td>
<td>17.102</td>
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<td>Export Rate %</td>
<td>73%</td>
<td>96%</td>
<td>96%</td>
<td>94%</td>
<td>93%</td>
<td>95%</td>
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**Trend of the Generator Sales**

for FY2009–FY2014

- Hitachi Co.
- Yasukawa Electric
- Fuji Electric
- Meidensha etc.

**Business environments have changed each year.**

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<tr>
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<td>11.749</td>
<td>19.042</td>
<td>6.136</td>
<td>5.68</td>
<td>0.617</td>
<td>9.953</td>
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<tr>
<td>Total Production</td>
<td>11.749</td>
<td>29.042</td>
<td>6.136</td>
<td>5.68</td>
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<td>11.453</td>
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<tr>
<td>Export Rate %</td>
<td>94%</td>
<td>45%</td>
<td>99%</td>
<td>95%</td>
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<td>0%</td>
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</table>
Offshore wind power developments in Japan have many hurdles now, but we can clear them gradually. Thank you for hearing.