Japan Wind Power Association (JWPA)

- Brief History
  - December 17, 2001: started as a Voluntary Association
  - April 1, 2010: incorporated as a General Incorporated Association with the present legal status

- Basic philosophy
  - to improve the energy security of Japan and contribute to solutions for global environmental issues including warming
  - to promote sound growth of the wind power industries at home and abroad
  - to conduct ourselves with strong awareness of responsibility as an industry group representing our country
  - to be accountable and maintain compliance by ensuring the function and ability to exert influence both internally and externally

- Composition of Members (as of February 15, 2017)
  - Number of members: 312 companies and groups covering whole wind industry
  - Our members are owning and running approx. 85% of wind power generating facilities in operation in Japan.
Present Status of Wind Power Development in Japan

① Wind power generating facilities in operation: 3,378MW
(as of E/March/2017 : estimated by JWPA)

② Projects under development & EIA process: 10,493MW
(as of E/January/2017: surveyed by JWPA)

<table>
<thead>
<tr>
<th>Project Area</th>
<th>MW</th>
<th>Status of EIA</th>
<th>MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hokkaido</td>
<td>2,533MW</td>
<td>Primary consultation</td>
<td>3,213MW</td>
</tr>
<tr>
<td>Tohoku</td>
<td>6,834MW</td>
<td>Scoping documents</td>
<td>3,510MW</td>
</tr>
<tr>
<td>others</td>
<td>1,126MW</td>
<td>Draft EIA</td>
<td>3,770MW</td>
</tr>
<tr>
<td>Total</td>
<td>10,493MW</td>
<td>Total</td>
<td>10,493MW</td>
</tr>
</tbody>
</table>

* Summed up figure(①＋②): 13,871MW
The figure of 10,000MW indicated in “2030 Energy Mix” for wind power generation seems achievable in the early stage of 2020s.

Major Challenge ①: Constraints in Grid Connection

Current Issues

① Cross-Regional Grid Operation yet to start
   The nation wide cross-regional grid operation has been long waited:
   - rules and regulations to be reformed comprehensively
   - OCCTO’s Long Term Vision of Cross-Reginal Network Development
     expected to be announced toward the end of March, 2017

② Grid Constraints getting harder in areas with good wind
   Hokkaido: New WF shall have battery to avoid variations of output to the grid
   Tohoku: Due to a plenty of new installation plans, the lack of thermal capacity of trunk transmission lines are anticipated ⇒ Concern: Heavy investment (cost allocation) and 10 years time for construction be required?

Solutions: The government committee (Grid WG) worked out certain alternative ideas to cope with the situations. The Wind industry is anxiously awaiting constructive and feasible proposals by electric utilities/OCCTO based on such discussions at Grid WG.
Major Challenge ①: Constraints in Grid Connection
Remark: latest update (as of March 7, 2017)

- New proposal by Hokkaido Electric (HEPCO)
  (announced and agreed in the Grid WG on March 7, 2017)
  HPCO proposed a new invitation for additional capacity for grid connection.
  ① Additional Capacity: 1,000MW (1st phase 600MW, 2nd phase 400MW)
  ② Batteries: — to be installed at the HEPCO’s grid side instead of each WF (present requirement)
    - expected required total capacity of batteries (15%-4h)
      for 1st phase; approx. 90MW–4h (installed toward FY2022)
      for 2nd phase; approx. 60MW–4h (to be decided)
    * battery capacity to be further studied and scrutinized
  ③ Cost allocation: to be shared by both generators and HEPCO

(for Reference) Grid issues, in middle / long term: Cost-effective reinforcement of grid infrastructure

OCCTO shall work fully to activate existing interregional grid connecting line
To select “wind power priority area” such as Hokkaido
To improve grid infrastructure at the selected priority area

- Improve the grid infrastructures according to the decommissioning of old facilities.
- To select “wind power priority area” is also effective for growing up wind power industry at that local area.
- Not only cross-regional grid connecting lines, but also local grid lines at good wind resource areas (Hokkaido & Tohoku) are important for wind power promotion in Japan.

* Source : JWPA Wind Vision 2016

Sources: Federation of electric power companies of Japan, transmission network, http://www.fepc.or.jp/enterprise/supply/soudensen/sw_index_01/index.html of Japan is machined to base source: federation of electric power companies of Japan transmission network http://www.fepc.or.jp/enterprise/supply/soudensen/sw_index_01/index.html of
Major Challenge ② : EIA Procedure

Current Issues
① Longer Process compared with major European countries and US

<table>
<thead>
<tr>
<th></th>
<th>US</th>
<th>Germany</th>
<th>Spain</th>
<th>UK</th>
<th>Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Criteria</td>
<td>&gt;50MW</td>
<td>&gt;50m height &amp; ≥20WTG</td>
<td>&gt;50WTG or &lt;2km from existing WF</td>
<td>&gt;50MW</td>
<td>≥10MW</td>
</tr>
<tr>
<td>Period</td>
<td>1～2Y</td>
<td>2Y</td>
<td>1.5～2Y</td>
<td>1.5～2Y</td>
<td>3～4/5Y</td>
</tr>
</tbody>
</table>

*investigated and prepared by JWPA

② JWPA’s Proposal
1) Reduction to half of EIA survey period and examination period
2) Formalizing advancement of EIA survey (demonstration projects are under trial jointly by METI and MOE)
3) Revision of criteria for project magnitude (≥10MW to ≥50MW)
4) Rationalizing evaluation items for survey (such as items during construction)

Topics  Offshore Wind Power Development (1)

Overview of Kitakyuushuu Port Project Site

1st Project pursuing Amendment of Port & Harbor Act just launched

Awarded to: Hibiki wind Energy Consoprtium
headed by Kyuden Mirai with J-Power, Hokutaku, Saibugas, Kyudenko
No. of WTG:max.44WTGs
Gen. capacity:228.8MW
Construction:expected to start in 2022

Offshore Wind Power Experience in Japan (2016)

- **Setana**
  - 2003
  - Vestas
  - 600kW
  - X 2 units
  - (Floating)

- **Hakata**, 2011
  - Lens type 3kW X 2 units
  - (Floating)

- **Sasebo**, 2009
  - 1/10 Model
  - (Floating)

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

- **Relocated to**
  - Fukuejima
  - 2016
  - Hitachi 2MW
  - (Floating)

- **Sakata**, 2004
  - Vestas
  - 2MW X 5 units

- **Hibikinada**
  - 2013
  - JSW 2MW

- **Akita**, 2015
  - Siemens 3MW

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

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

*Total installed:* 60MW
*Total planned:* 1,926MW

Note: FHI's WTG division has merged by Hitachi in July 2012.

Source: investigated by JWPA

---

Reducing Wind Curtailment through Transmission Expansion in a Wind Vision Future

Jennie Jorgenson, Trieu Mai, and Greg Brinkman
National Renewable Energy Laboratory

Technical Report
NREL/TP-6A20-67240
January 2017

Source: NREL web site at www.nrel.gov/publications
Aiming at Sustainable Expanding Deployment of Wind power in Japan
— JWPA Wind Vision Report —

March 2, 2016
The Japan Wind Power Association (JWPA)
http://jwpa.jp/en

Scope of JWPA Wind Vision Report

<table>
<thead>
<tr>
<th>No.</th>
<th>Challenges</th>
<th>Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>To achieve grid parity</td>
<td>Medium / long term tactics for LCOE reduction</td>
</tr>
<tr>
<td>2</td>
<td>To harmonize with grid operation</td>
<td>Realistic strategies for grid connection along time line</td>
</tr>
<tr>
<td>3</td>
<td>High reliability, Job creation</td>
<td>To improve safety, human resources, financing, etc.</td>
</tr>
</tbody>
</table>

Practical tactics for the challenges
Recognizing the challenges
Safe and stable power supply, Minimize public burden

Wind Power Energy Resources and Mid/Long Term Target Ver. 4.3 (released by JWPA in June 2014)

JWPA’s basic principles
1. To mitigate global warming and secure Japanese energy security by promoting wind power
2. To organize and to grow up wind power industry for promoting wind power
3. To act with responsibility as the representative for Japanese wind power industry group
4. To establish enough abilities for lobbing, and to keep accountabilities
1. World wind power development trend

- Wind power shall increase more than 1,000GW by 2040 by IEA forecast.
- It is the largest among all kinds of electric power plants.
- 2.5 trillion dollars shall be invested for the wind power.
- Most of nations with large GDP promote wind power.
- COP21 at Paris in Dec. 2015 will accelerate the world wind power in further.

2. Roadmap for the Wind Power Introduction for Japan, proposed by JWPA

3. Scenario for future wind power in Japan

   (1) 5 driving forces: Reduce LCOE, Harmonize with electrical grid, Repowering, Offshore wind, Establishing domestic supply chain

   (2) Time & Area: Challenges for grid interconnection by time lines.

4. Future prospects for LCOE reduction in Japan

5. Grid issues

   In short term: To improve grid operation under cross-area management
   In middle & long term: Cost-effective reinforcement of grid infrastructure

6. To promote Repowering

7. To promote Offshore wind power development

8. Other challenges: Easing the hurdles

---

**1. World wind power development trend**

- Wind power shall increase more than 1,000GW by 2040 by IEA forecast.
- It is the largest among all kinds of electric power plants.
- 2.5 trillion dollars shall be invested for the wind power.
- Most of nations with large GDP promote wind power.
- COP21 at Paris in Dec. 2015 will accelerate the world wind power in further.

**Prospects for renewable energies in the world**

- **Etc.,** Geothermal, Solar, Wind, Re-Energy rate

**Wind Power rank:** 1st 2nd 3rd 4th 5th 6th 7th 8th 9th 10th 19th

**GDP Rank:** 1st 2nd 4th 14th 9th 5th 11th 6th 8th 7th 3rd

---

**The large GDP top nations promote wind power**

**World wind power introduction amount tops 10 countries (2014)**

**Investment for wind is 2.5 trillion dollars, which is the largest**

**Investment estimates in electric world power (2015 to 2040 annual)**

- **Fossil fuel, Nuclear power, Renewable energies, Transmission and distribution**
2. Roadmap for the Wind Power Introduction for Japan, proposed by the JWPA

- 10GW prospect at “Energy mix plan” shall be achieved at early 2020s.
  (3.1GW at 2015 + 7.1GW in the EIA process = 10GW)
- JWPA proposes 36.2GW toward 2030 for the next stage.

Roadmap for the introduction of wind power

3. Scenario for future wind power in Japan

(1) 5 Driving forces

- JWPA considers there are 5 driving forces for wind power in Japan
- If we can handle them, wind power mass introduction shall be realized.

To reduce LCOE
- Achieve grid parity / competitiveness
- Mass production achieves volume discount.
- To improve capacity factor & availability

To Improve Grid infrastructure
- Install at good wind condition area
- Aggregation
- Inter regional grid operation
- Effective control, Output forecast

To promote Repowering
- To promote new large high performance wind turbines instead of old ones

To promote Offshore wind
- To harvest huge offshore wind energy resources

To establish domestic supply chain
- To activate wind turbine & components industries in Japan
- Job creation by “Green new deal”
3. Scenario for future wind power in Japan
(2) Challenges for onshore wind grid Interconnection by time & area

- For onshore wind, Grid connection has large priority.
- Kyushu area has some margin. We have to accelerate this area at first
- Hokkaido & Tohoku which have small acceptable capacities now, we manage to send their electricity to demand/population center (Tokyo).

(Short terms: up to 5 years)
- Inter regional grid operation
- To use existing pump up hydro plants and middle load fossil fired power plants
- Out put control for renewable energies
- Re-estimation of acceptable capacity

(About long term: 5~15 yrs)
- Optimization of transmission network to achieve “Energy mix plan”
- To improve inter-regional grid lines; Hokkaido/Tohoku: 2.7GW Tohoku/Tokyo 3.2GW

Reference: “Master plans workshops interim report on strengthen including inter-regional interconnecting line”
(April, 2012, Ministry of economy, trade and industry)

4. Future prospects for LCOE reduction in Japan

- We expect cost will decrease after 2020 to 8-9 JPY/kWh toward 2030 by mass production and technology innovations.
- Cost reduces moderately until 2020, because construction cost won’t decrease due to big demand for coming Olympic game preparation.

Cost estimation by experience curve (cumulative output expansion effect*)

<table>
<thead>
<tr>
<th>Item</th>
<th>Generation cost improvement effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>50% increase in swept area</td>
<td>-1.99 JPY/kWh</td>
</tr>
<tr>
<td>Life extension (20 years → 25 years)</td>
<td>-1.88 JPY/kWh</td>
</tr>
<tr>
<td>Improvement of utilization rate and capacity factor through adoption of CMS</td>
<td>-1.69 JPY/kWh</td>
</tr>
<tr>
<td>20% reduction of nacelle weight</td>
<td>-1.28 JPY/kWh</td>
</tr>
<tr>
<td>Improvement of maintenance efficiency</td>
<td>-0.51 JPY/kWh</td>
</tr>
<tr>
<td>5% increase in wind turbine efficiency</td>
<td>-0.39 JPY/kWh</td>
</tr>
<tr>
<td>25% increase in tower height</td>
<td>-0.25 JPY/kWh</td>
</tr>
</tbody>
</table>

* Cost calculation for cumulative output expansion effect and individual technological innovation effects is based on completely different approaches. Besides, individual technological innovation effects are estimated by summing maximum values of all elements, while actual attainability is different for each element.
5. Grid issues, in short term: to improve grid operation

- Output curtailment for renewable energies (solar and wind) shall be requested by grid stabilities in Japan now.
- "Hour unit base" is better than "Day unit base" at curtailment.
- If we consider solar and wind at harmonizing (sharing), wind power can get additional acceptable capacity and can reduce the curtailment.

Examples of estimation of wind power introduction and output suppression rate in every area (JWPA)

<table>
<thead>
<tr>
<th>Area</th>
<th>Wind power introduction</th>
<th>Output suppression rate (suppression days)</th>
<th>Output suppression rate (suppression hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hokkaido</td>
<td>1.5 GW</td>
<td>25.4% (74 days)</td>
<td>5.5% (739 hours)</td>
</tr>
<tr>
<td>Tohoku</td>
<td>6 GW</td>
<td>18.6% (41 days)</td>
<td>4.0% (370 hours)</td>
</tr>
<tr>
<td>Kyusyu</td>
<td>9 GW</td>
<td>27.9% (54 days)</td>
<td>8.2% (648 hours)</td>
</tr>
</tbody>
</table>

Introduction of wind power generation at a level close to that of solar power generation is possible in areas suitable for wind power generation (Hokkaido, Tohoku, Kyushu) through utilizing the fullest extent of existing equipment.

Wind power generation and solar power generation complement each other.

- Efficient sharing in a power system is possible, while mutual hindrance in introduction expansion is not likely.

Example of measured output of solar power generation in Germany (2014)

- Installed capacity of solar power generation: 3,184,746 million W
- Installed capacity of wind power generation: 3,761,106 million W

5. Grid issues, in middle / long term: Cost-effective reinforcement of grid infrastructure

- Improve the grid infrastructures according to the decommission of old facilities.
- To select "wind power priority area" is also effective for growing up wind power industry at that local area.
- Not only inter regional grid connecting lines, but also local grid lines at good wind resource area (Hokkaido & Tohoku) are important for wind power promotion in Japan.
6. To promote Repowering

- Old wind turbines (operated for 20 years) shall increase after 2020. Most of them stand at good wind conditions.
- To Promote terminating old turbines and rebuilding new large high performance turbines.

**Merits for repowering**
- To prevent accidents
- To improve power output
- To keep Japanese wind power installation
- Job creation at local districts
- To add demand for wind turbine industries

![Graph showing wind turbine repowering over time](image)

To create wind turbine repowering market, we have to organize the related rules & industries.

7. To promote Offshore wind power development

- Offshore wind power development is a good way for mass introduction.
- But, it needs efforts to remove the hurdles, such as: long EIA process, Grid connection, Law modification for general common sea area, Jack up ships, Port away bearing strength, etc.

**Schedule for expansion of offshore wind power introduction**

- FY 2015 - 2030
- Maintenance of transmission lines
- Construction works
- Area zoning for wind turbine facilities
- Formulation of rules for sea area utilization
- Area zoning
- Reconciliation among interested parties in environmental assessment
- Public recruitment of business operators
- Construction works in Area 1
- Construction works in Area 2
- Construction works in Area 3
- Recruitment for Area 1
- Recruitment for Area 2
- Recruitment for Area 3
- Recruitment for Area 4
- Recruitment for Area 5
- Recruitment for Area 6
- Recruitment for Area 7
- Recruitment for Area 8
- Recruitment for Area 9
- Recruitment for Area 10
- Recruitment for Area 11
- Recruitment for Area 12
- Recruitment for Area 13
- Recruitment for Area 14
- Recruitment for Area 15
- Recruitment for Area 16
- Recruitment for Area 17
- Recruitment for Area 18
- Recruitment for Area 19
- Recruitment for Area 20
- Recruitment for Area 21
- Recruitment for Area 22
- Recruitment for Area 23
- Recruitment for Area 24
- Recruitment for Area 25
- Recruitment for Area 26
- Recruitment for Area 27
- Recruitment for Area 28
- Recruitment for Area 29
- Recruitment for Area 30

**Experience:** 52.6 MW
**Planned:** 1,392 MW

[Map showing offshore wind power development](image)

Source: including the meeting small commission term energy supply-demand projection (4th time)
8. Other challenges: Easing the hurdles

- Easing regulations against wind power introduction in Japan. (Expanding wind farm sites candidates all over Japan)
- R&D for innovative wind turbines matching Japanese climate and terrains, etc. (Aiming at cost effective facilities)
- Improving project management skill, from development through to O&M (Improvement of project quality)
- Establishing supply chain of wind industry and promoting domestic wind related industries. (Bringing-up domestic industries)
- Promoting cost-effective and diversified financing sources to sustainable investment (Stimulating robust investment)
- Contribution for preventing global warming, securing higher social acceptance, contributions for local economies. (Getting national consensus and citizen support)

---

Thank you!

2.4 MW offshore wind turbine of NEDO’s project at Choshi in Ibaragi pref. Source: JWPA photo contest in 2013