# 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

一般社団法人 日本風力発電協会
JWPA Japan Wind Power Association

# Scope of JWPA WindVision Report



## Challenges and Solutions

| No. | challenges | Solutions |
|---|---|---|
| 1 | To achieve grid parity | Medium / long term tactics for LCOE reduction |
| 2 | To harmonize with grid operation | Realistic strategies for grid connection along time line |
| 3 | High reliability, Job creation | To improve safety, human resources, financing, etc. |

Practical tactics for the challenges

Safe and stable power supply,
Minimize public burden

Recognizing the challenges

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

**'Long-term Energy Supply and Demand Outlook (2030 Energy Mix)' (released by the Ministry of Economy, Trade and Industry in July 2015)**

## JWPA's basic principles

1. To mitigate global warming and secure Japaneses 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

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1. World wind power development trend
2. For the wind power mass introduction in future Japan (JWPA proposes 36GW or more towards 2030)
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

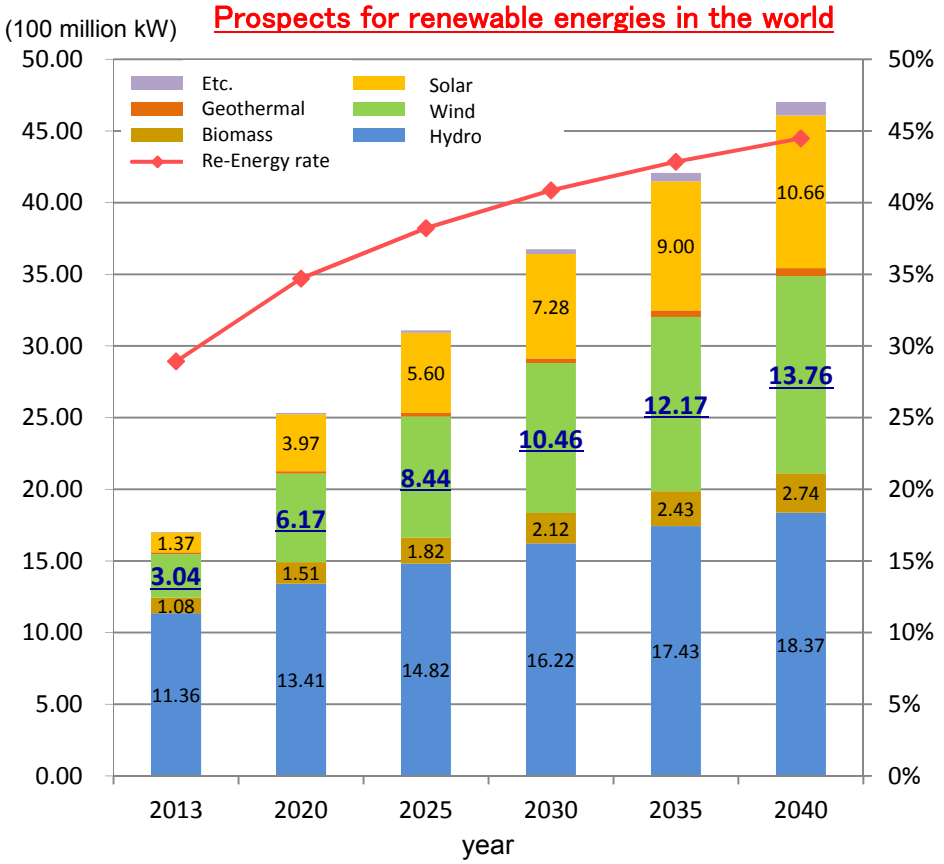
   In middle & long term: Cost-effective reinforce grid infrastructure

6. To promote Repowering
7. To promote Offshore wind power development
8. Other challenges : Easing the hurdles

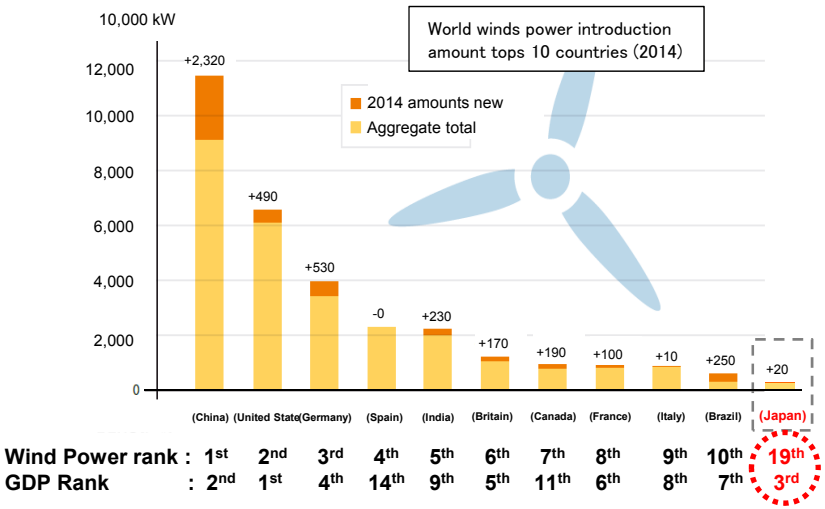
# 1. World wind power development trend

- Wind power shall increase more than 1,000GW by 2040 by IEA forecast.
- It is the largest among the 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.

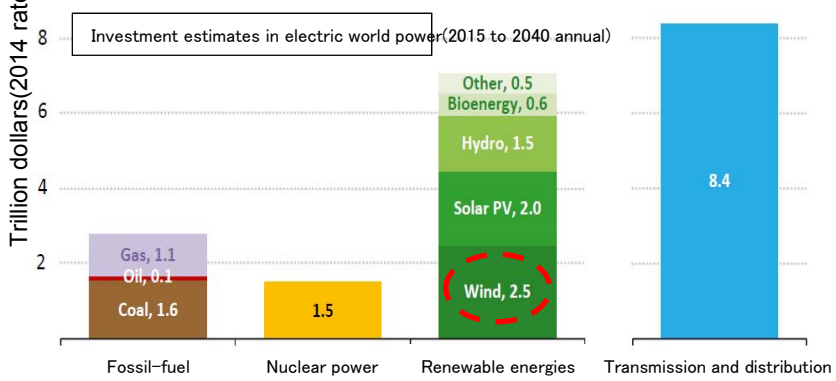
## Prospects for renewable energies in the world




## The large GDP top nations promote wind power




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

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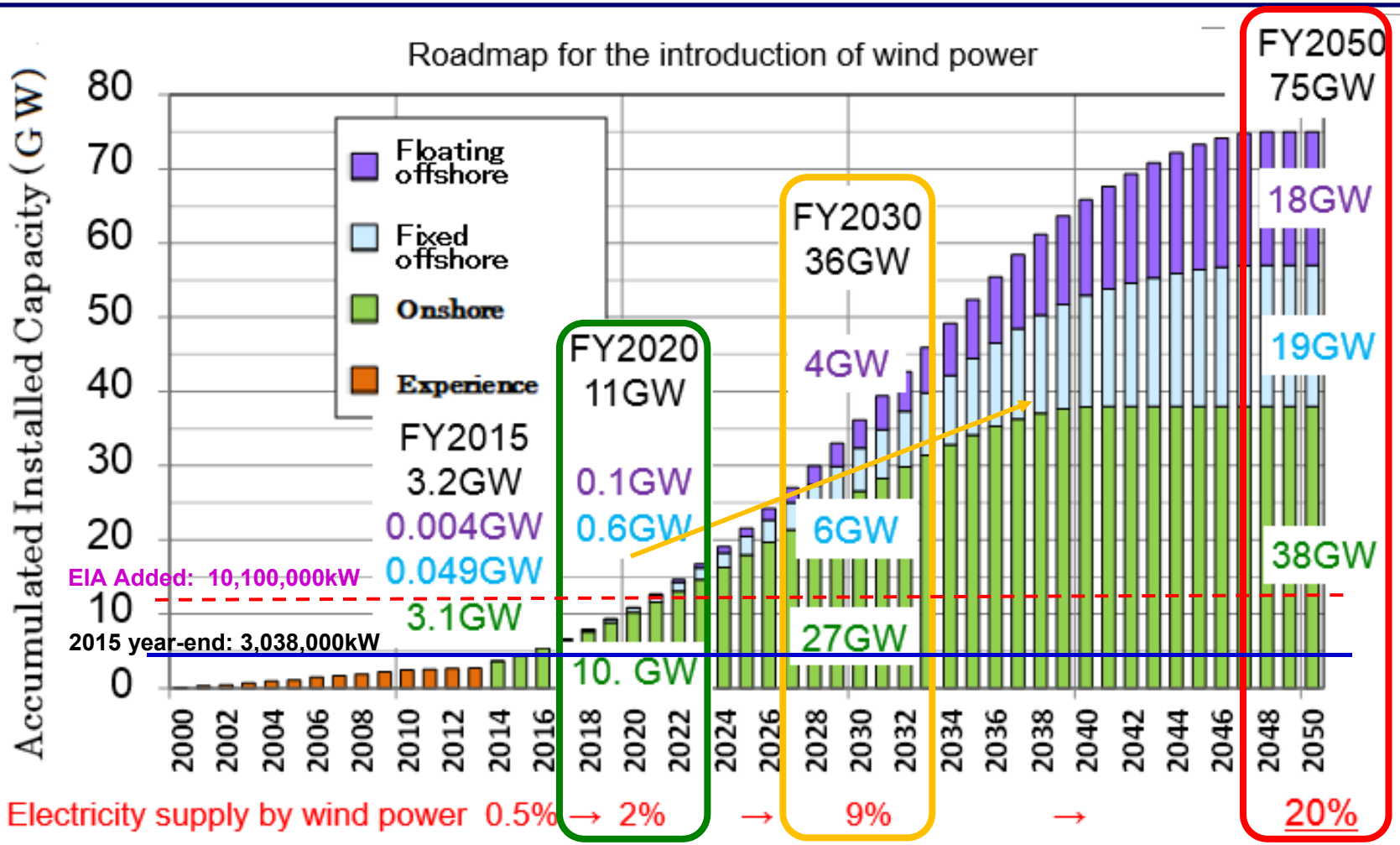
Source: World Energy Outlook 2015, IEA among, "New Policy Scenario"
REN21 Renewables 2015 Global Status Report

# 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.



# 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 handles 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

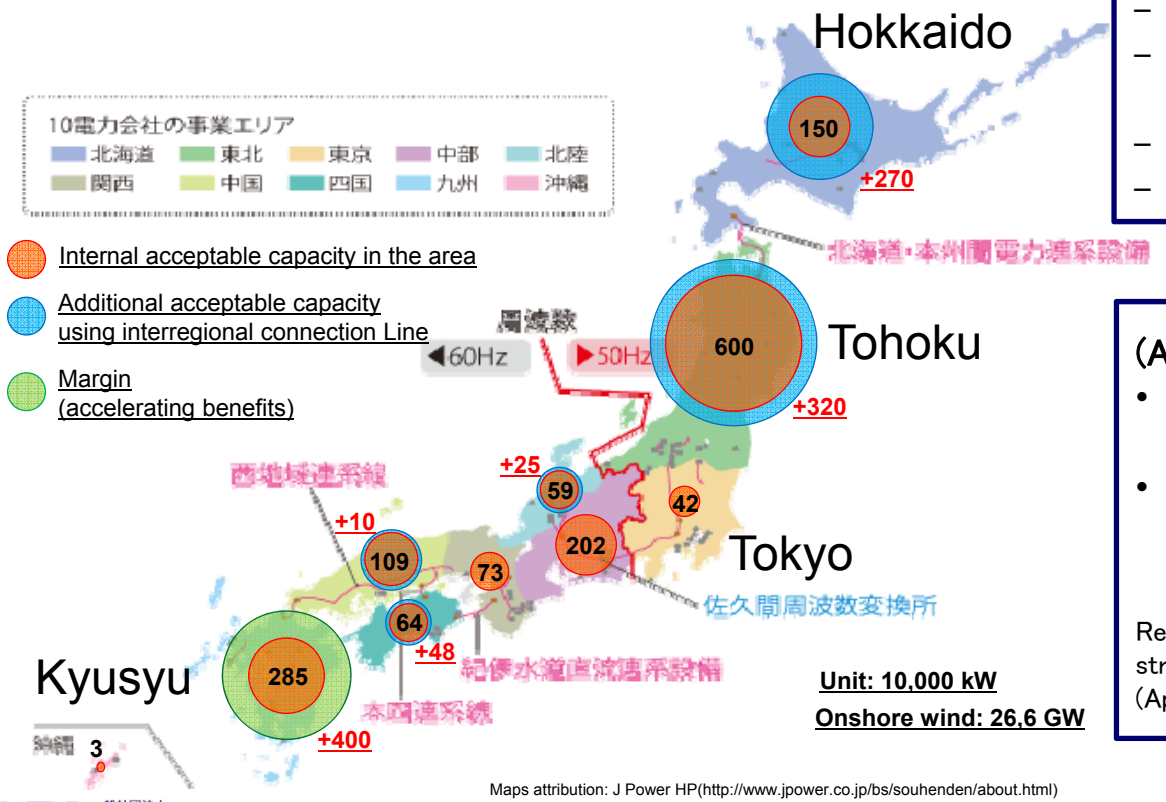
**To establish domestic supply chain**
- To activate wind turbine & components industries in Japan
- Job creation by “Green new deal”

→ **Wind power mass introduction in Japan**

# 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).




Unit: 10,000 kW

Onshore wind: 26,6 GW

Maps attribution: J Power HP(http://www.jpower.co.jp/bs/souhenden/about.html)

(Short terms: up to 5 years)

- Inter regional grid operation
- To use existing pomp 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 yers)

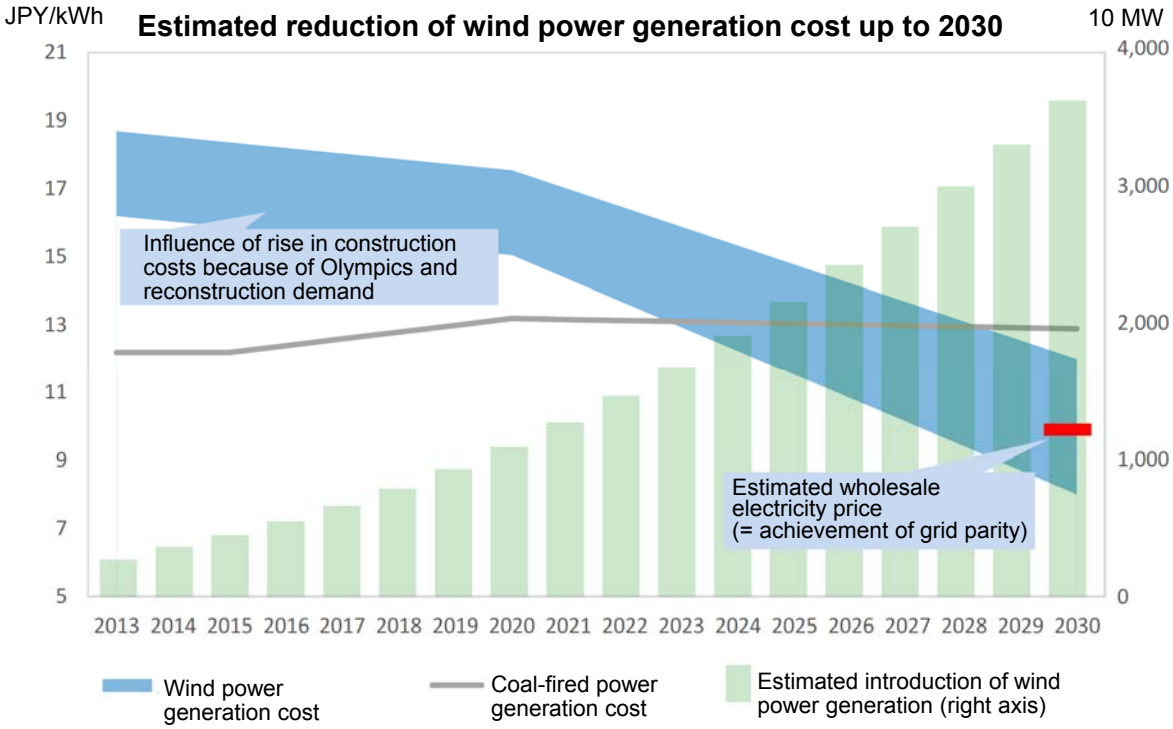
- Optimization of transmission network to achieve "Energy mix plan"
- To improve inter-reginal grid lines;
  Hokkaido/Tohoku: 2.7GW
  Tohoku/Tokyo 3.2GW

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.

**Estimated reduction of wind power generation cost up to 2030**




* 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.

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

| Introduction of onshore wind power generation (period) | Capital costs | Operating and maintenance costs |
|---|---|---|
| 2.71 GW (March 2013) | 300 thousand JPY/kW | 6,000 JPY/kW/year |
| 2.94 GW (March 2015) | 316 thousand JPY/kW | 11,000 JPY/kW/year |
| 10 GW (2020) | 263 – 271 thousand JPY/kW | 4,800 – 5,220 JPY/kW/year |
| 26.6 GW (2030) | 239 – 253 thousand JPY/kW | 4,098 – 4,590 JPY/kW/year |

**Cost estimation with regard to technology (individual technological innovation effects*)**

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

# 5. Grid issues, in short term : To improve grid operation

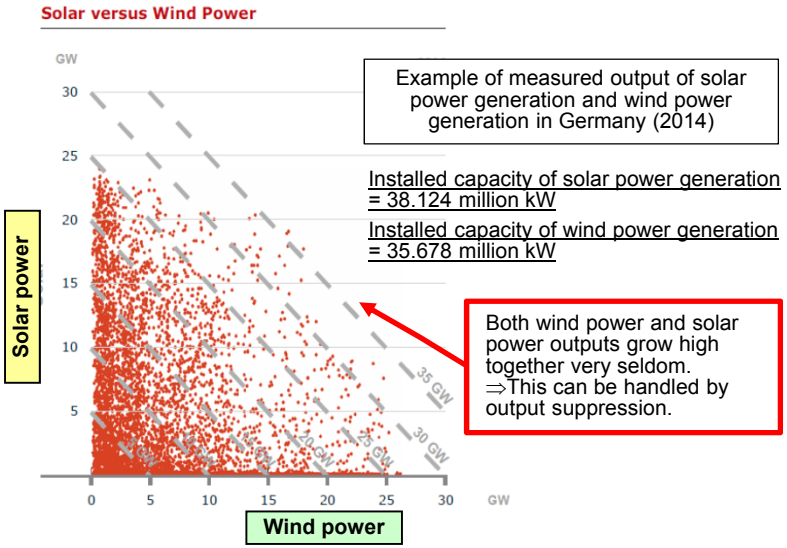
- Output curtailment for renewable energies (solar and wind) shall be requested by grid stabilities in Japan now.
- "Hour unit base" is better than "Day unit base" at curtailment.
- If we consider solar and wind at harmonizing(sharing), wind power can get additional acceptable capacity and can suppress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

**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.**

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

| Area | Wind power introduction | Output suppression rate (suppression days) <Day unit base> | Output suppression rate (suppression hours) <Hour unit base> |
|---|---|---|---|
| Hokkaido | 1.5 GW | 25.4% (74 days) | 8.5% (739 hours) |
| Tohoku | 6 GW | 18.6% (41 days) | 4.0% (370 hours) |
| Kyusyu | 9 GW | 27.9% (54 days) | 8.2% (648 hours) |

**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.**




* In this simulation, outputs of solar power generation and wind power generation are suppressed in such way that residual demand with respect to the actual demand in 2013 (residue of power demand less power generated by solar and wind power plants) does not drop below a set lower limit; as to wind power, the control method is intended for suppression of the output ceiling in a whole area operated by every power company, in units of hours (maximum output suppression control).

* In this simulation, static demand-and-supply balance is considered solely in terms of 'maintenance of minimum residual demand' aiming to eliminate the deficit of decrease capacity. Therefore, the following factors are disregarded, and actual wind power introduction and output suppression rate (output suppression time) may be different from the simulated results.
①Year-to-year variation of power demand conditions. ② Errors of demand forecast, solar power output forecast, and wind power output forecast (including, for example, a possibility that solar and wind power outputs exceed respective maximum values (2σ)). ③ Time constraints on start/stop of thermal power generators, hydro power generators, and other conventional power sources (as regards installed capacity and operation methods of power generators, minimum residual demand, introduction and output suppression time of solar power plants, and other data for 2013, the calculations are based on the data shown by 3rd System WG).

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

OCCTO shall work fully to activate existing inter regional grid connecting line

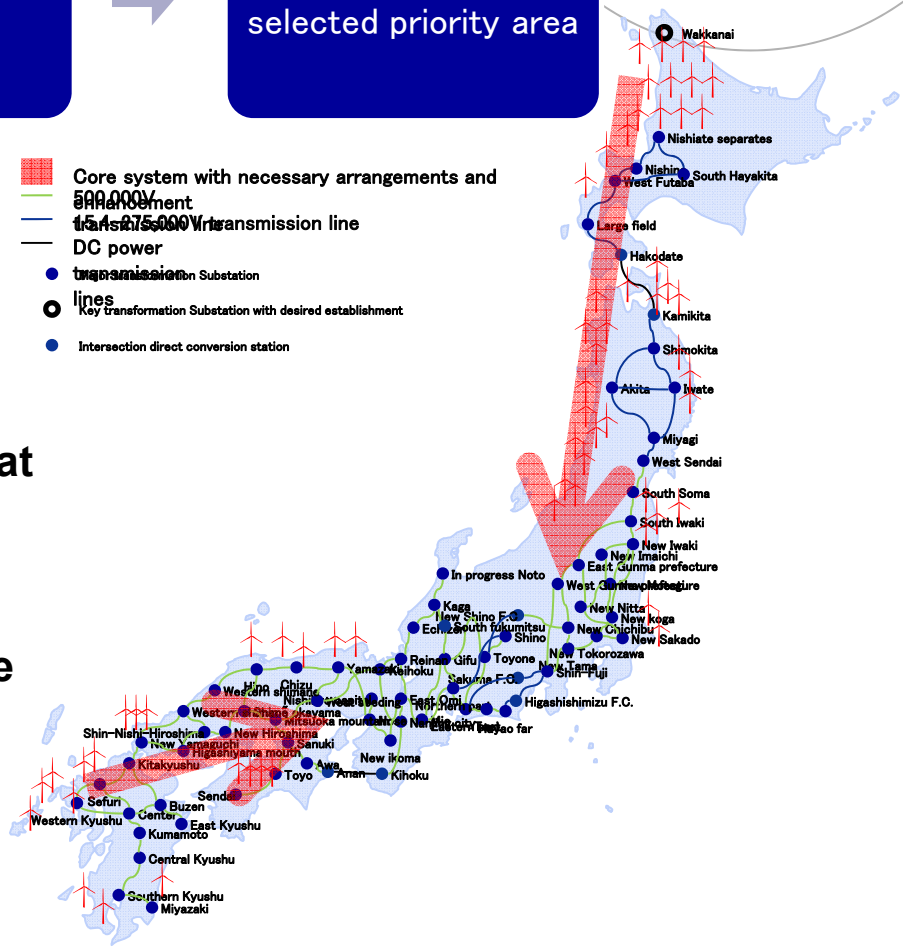
→

To select "wind power priority area" such as Hokkaido

→

To improve grid infrastructure at the selected priority area

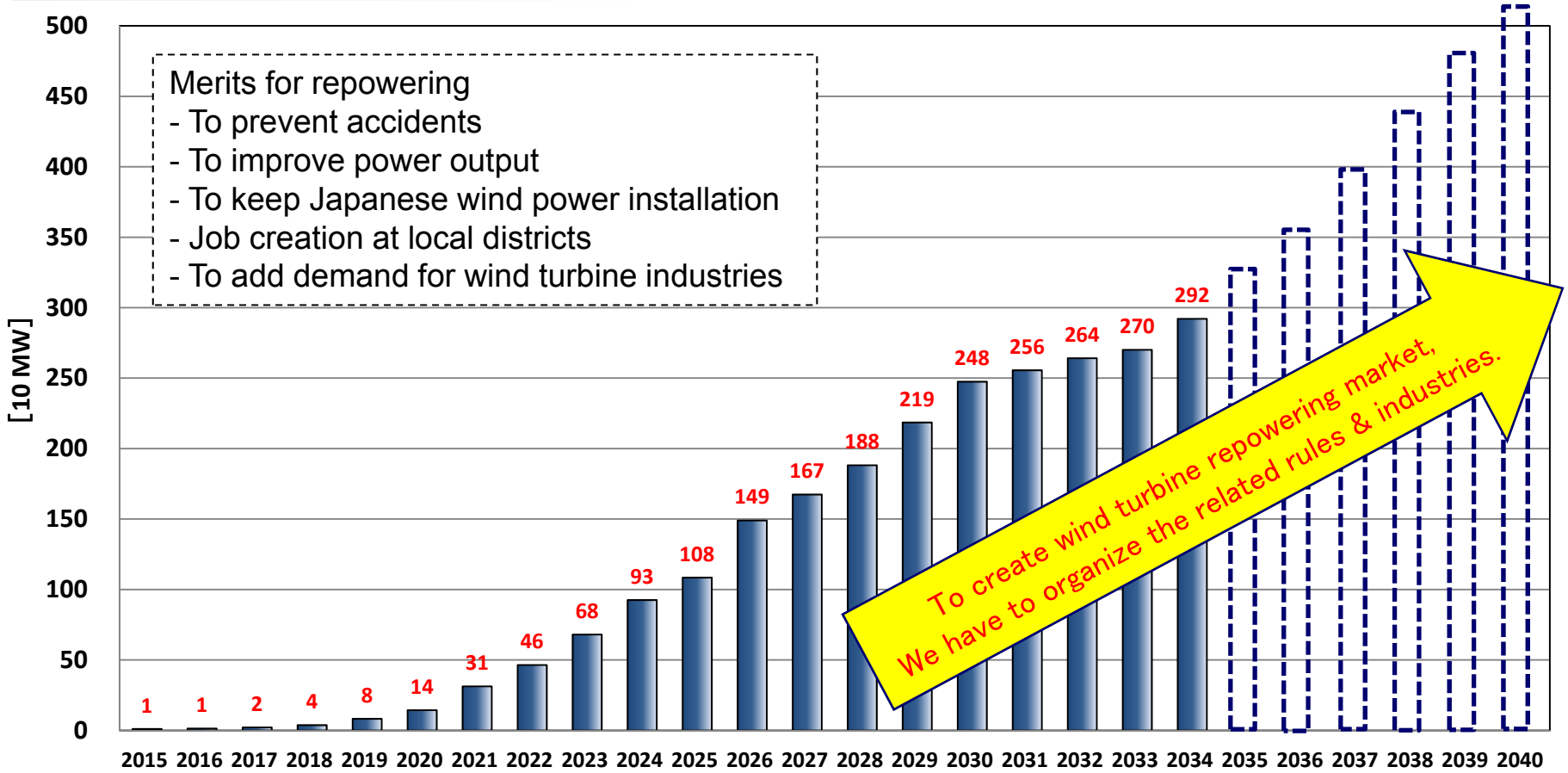
- **Improve the grid infrastructures according to the decommission of old facilities.**
- **To select "wind power priority area" is also effective for growing up wind power industry at that local area.**
- **Not only inter regional grid connecting lines, but also local grid lines at good wind resource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




Sources: Federation of electric power companies of Japan, transmissions 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

# 6. To promote Repowering

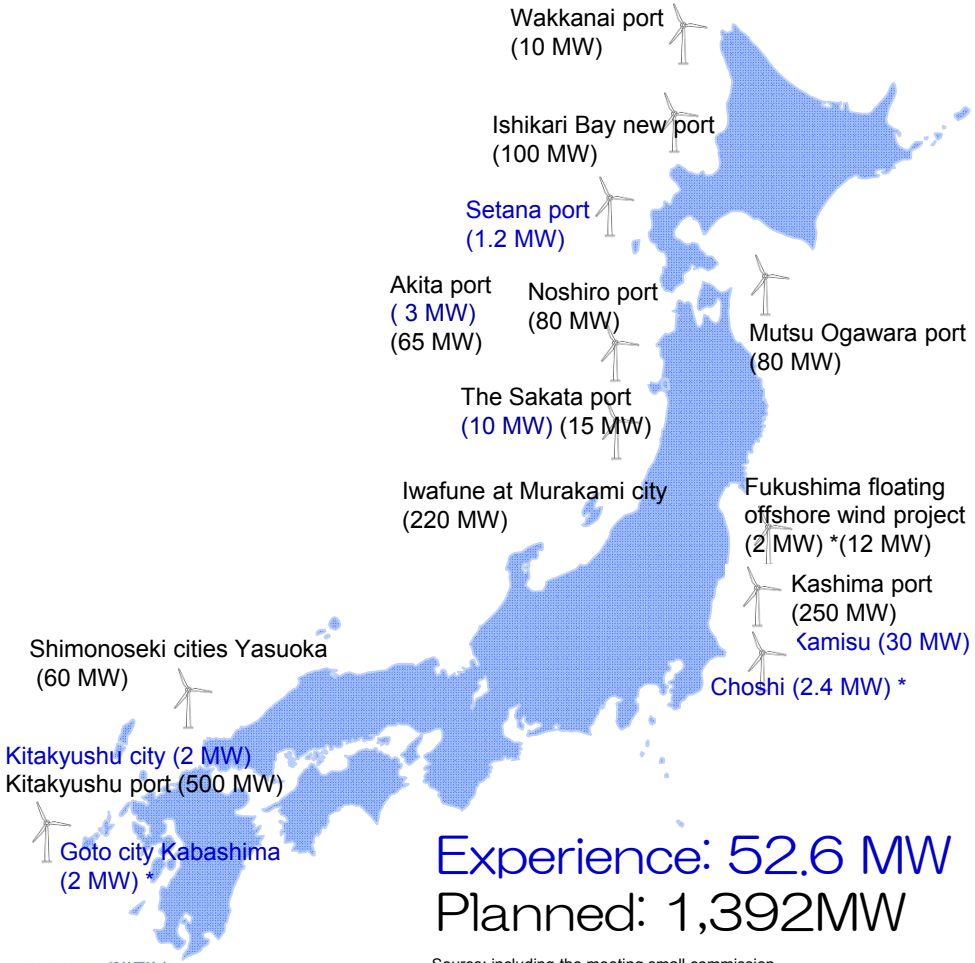
- Old wind turbines (operated for 20 years) shall increase after 2020. Most of them stand at good wind conditions.
- To Promote terminating old turbines and rebuilding new large high performance turbines.



# 7. To promote Offshore wind power development



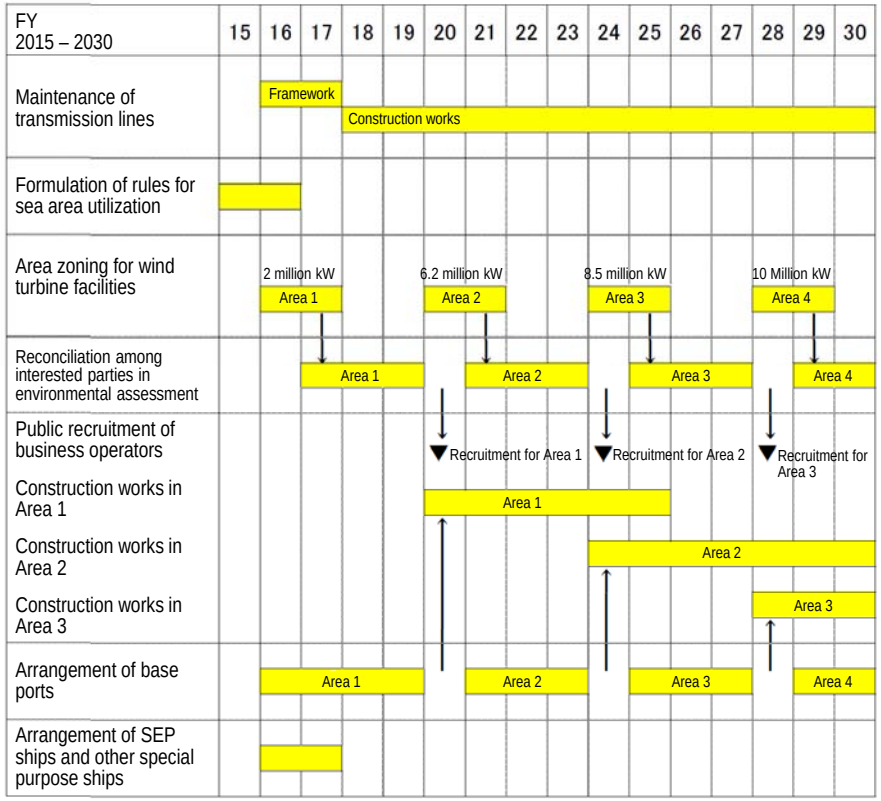
- Offshore wind power development is a good way for mass introduction.
- But, it needs efforts to remove the hurdles, such as; long EIA process, Grid connection, Law modification for general common sea area, Jack up ships, Port qway bearing strength, etc.




Experience: 52.6 MW
Planned: 1,392MW

Source: including the meeting small commission term energy supply-demand projection (4th time)

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




Source: compiled by JWPA

# 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 dmestic 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)

2.4 MW offshore wind turbine of NEDO's project at Choshi in Ibaragi pref.

Source: JWPA photo contest in 2013