Feed in Tariff of Wind Power through Offshore Wind in Japan

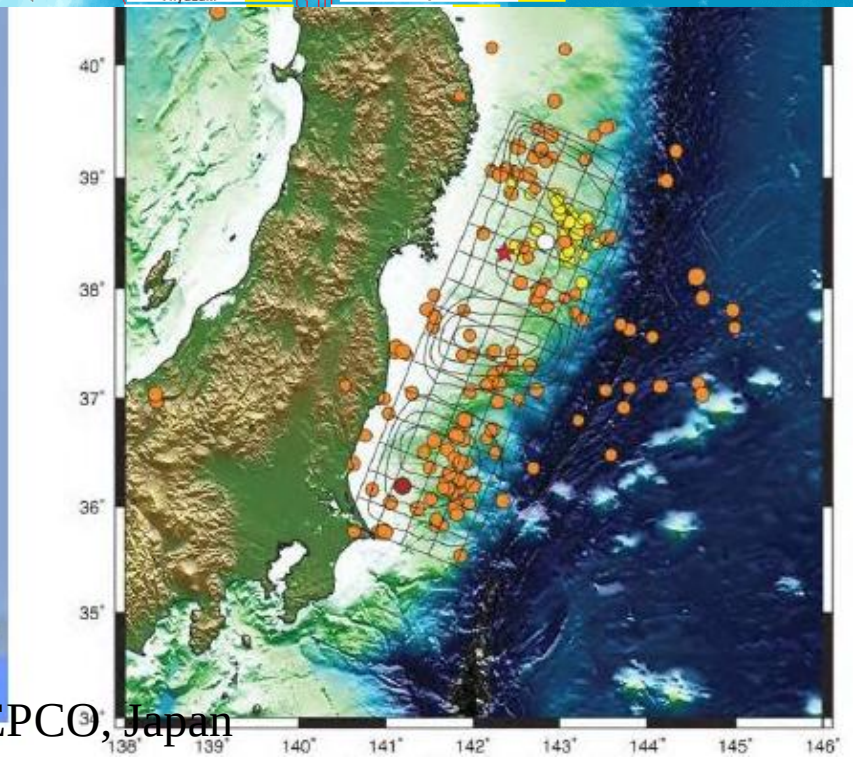
Chuichi Arakawa
The University of Tokyo

Kamisu, Japan / 2MW x 7

・This wind farm withstood Tsunami on 3.11
・7 units of 2MW Wind Turbine
・Being developed as private sector for future such as more 7 units and Giga-watt farm

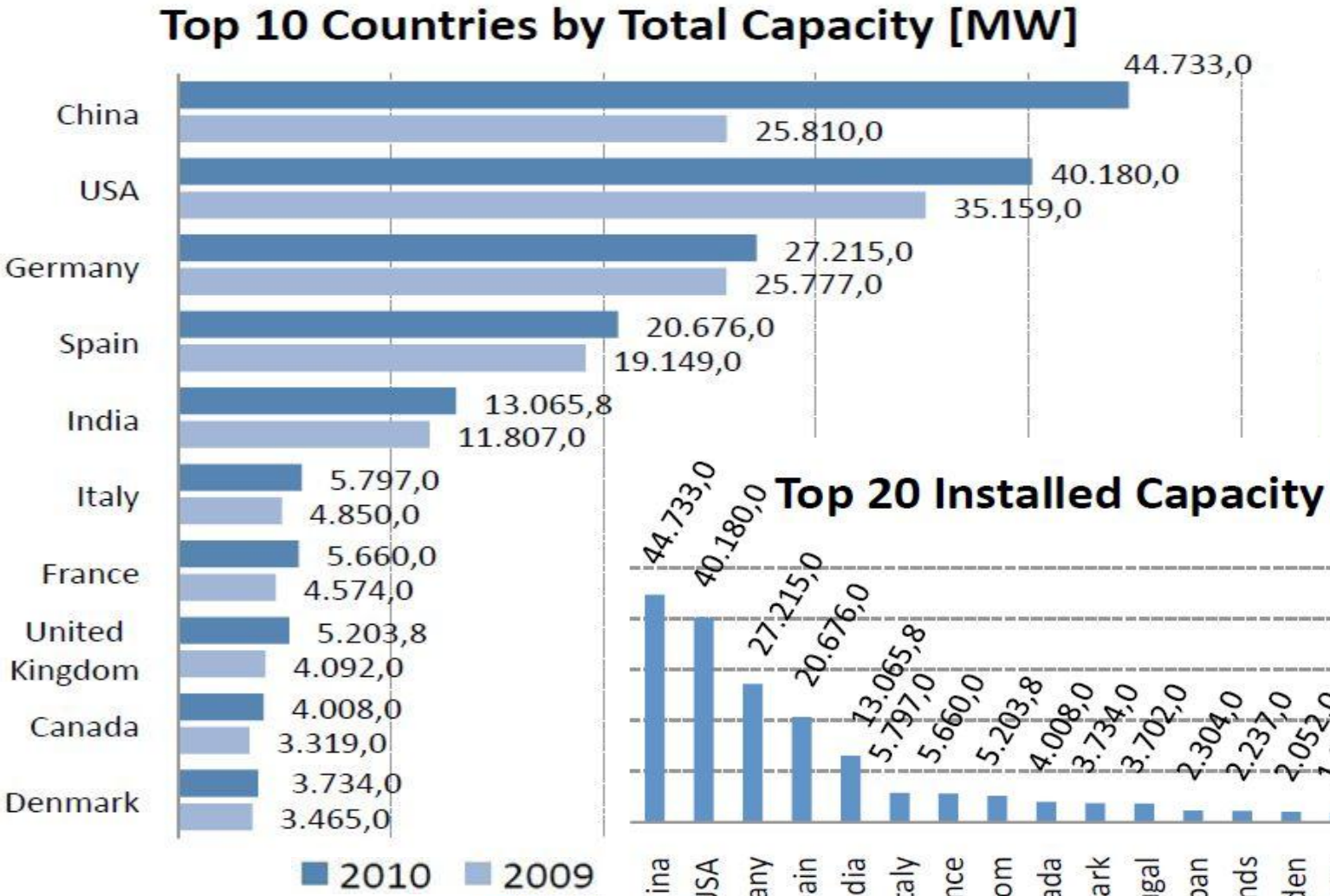
2011 Earthquake off the Pacific Coast of Tohoku, Japan

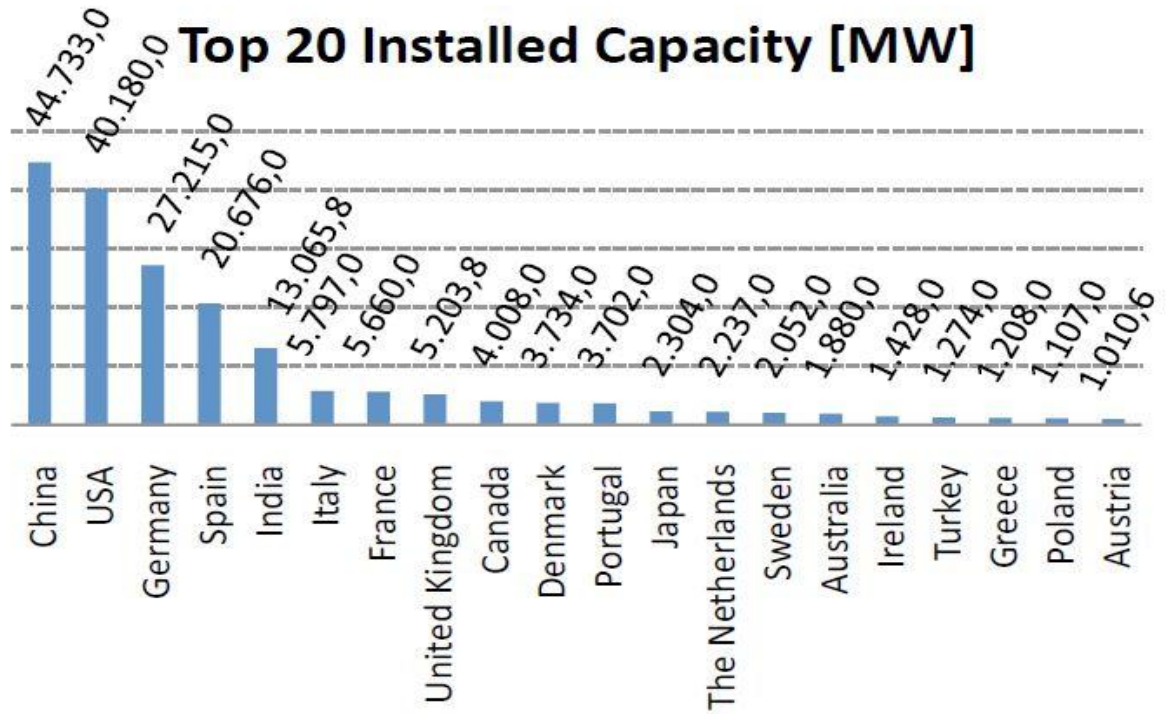
March 11, 2011, Magnitude 9.0
Tsunami reached heights of up to 40.5m and travelled up to 10km.
It caused meltdown of three reactors in Fukushima nuclear power plants.



From interim report of TEPCO, Japan

Total Capacity of Wind Power





From WWEA Annual Report

New Guideline for Wind Turbines in Japan and Asian Area

Typhoon Attack

Miyako Island was hit by huge Typhoon #14 on 11.Sep.2003 and all 7 WT were destroyed; 3 fallen down, 3 lost blades, 1 lost nacelle roof

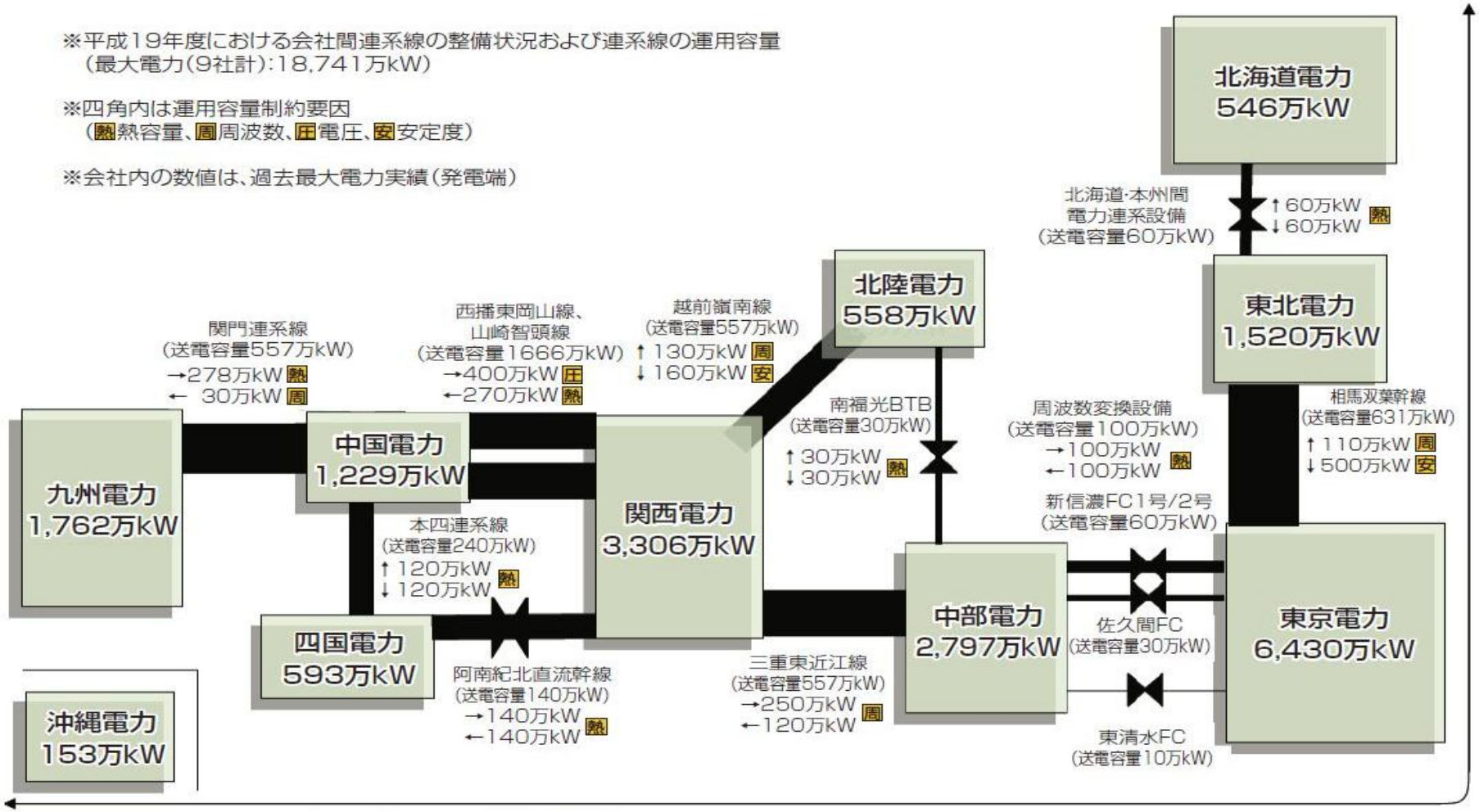
NEW MW-class Machines in Japan

MWT92 (MHI) 2.4MW WT

SUBARU 80/2.0 (FHI) 2 MW WT

Grid Connection in Japan

- Wind power was not allowed to use grid connection between each area.
- Wind potential exists strongly in Hokkaido, Tohoku and Kyushu.

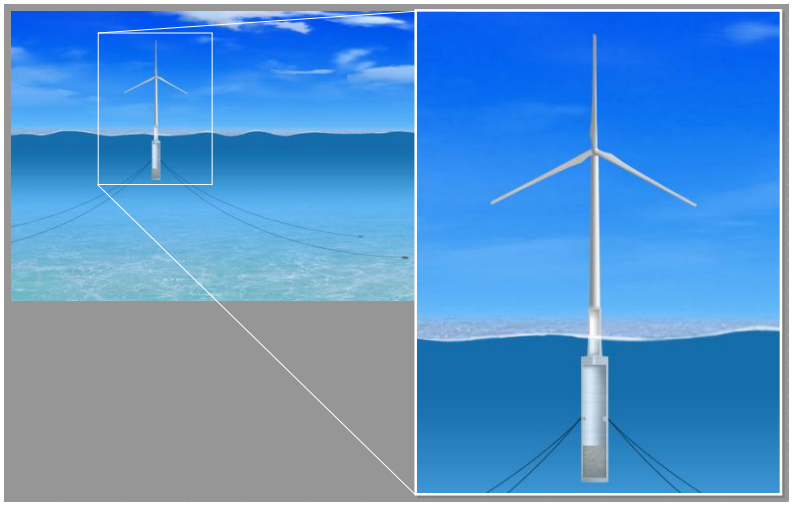


NEDO R&D Offshore Windpower Generation

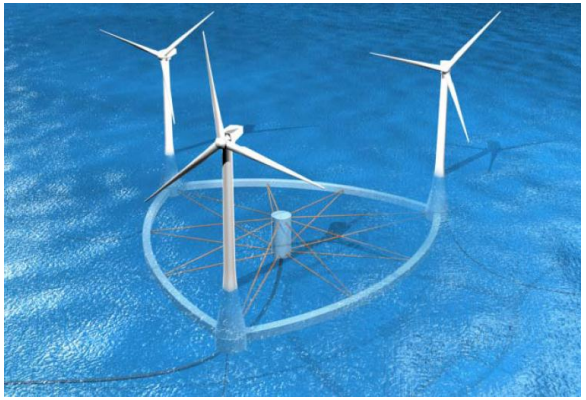
- Offshore Windturbine Demonstration PJ
  - 2.4MW at Choshi, 2MW at Hibikinada in 2012
- Offshore Windfarm Feasibility Study
  - 4 districts are chozen in 2011.
- Super Large Windturbine Development
- Ocean Energy Potential Study
- Floating Offshore Windturbine Basic study

However, we have delay of more than 10 years for offshore in Europe. Furthermore, the national project is planned to have only one turbine. We should accelerate wind power to cover nuclear in high speed.

Domestic Project of Deep Offshore

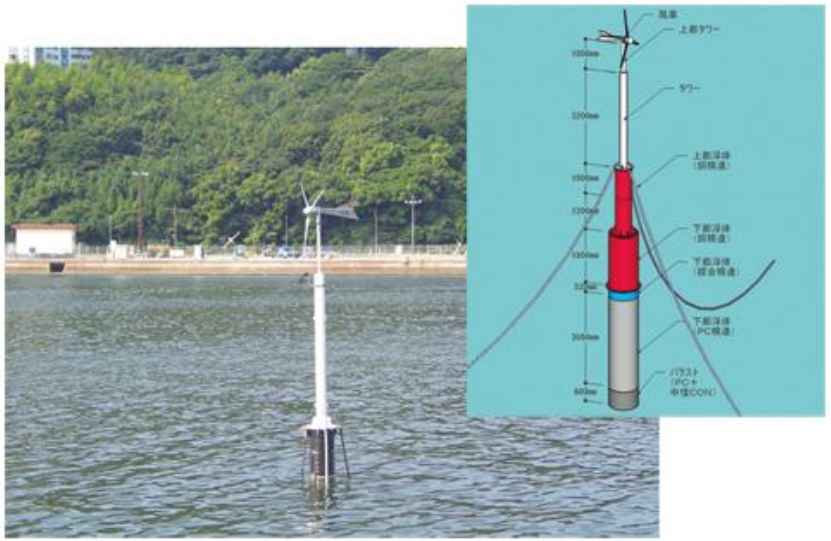


Spar type ; Prof. Suzuki in Uni. of Tokyo



Semi-sub type ; Prof. Ishihara in Uni. of Tokyo, TEPC O, etc

Sailing type ; Environment Institute & Prof. Kinoshita in Uni. of Tokyo

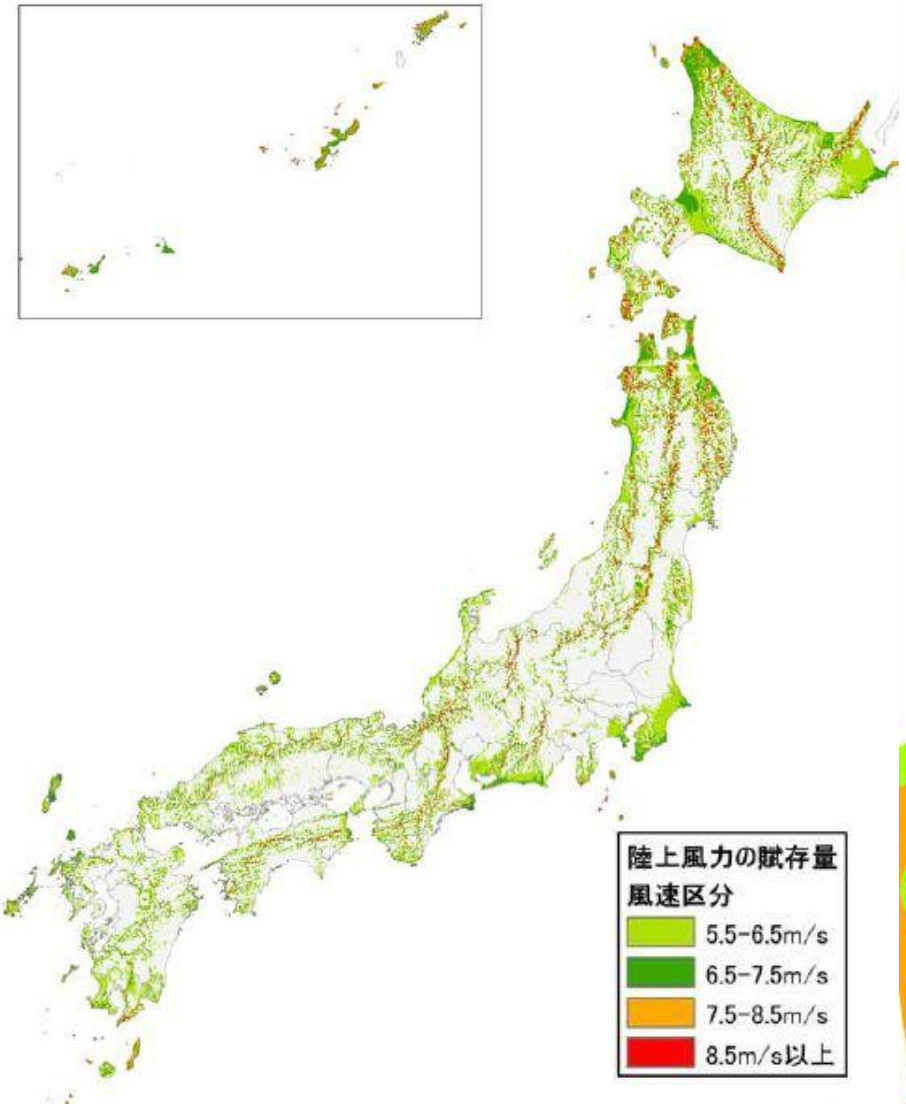


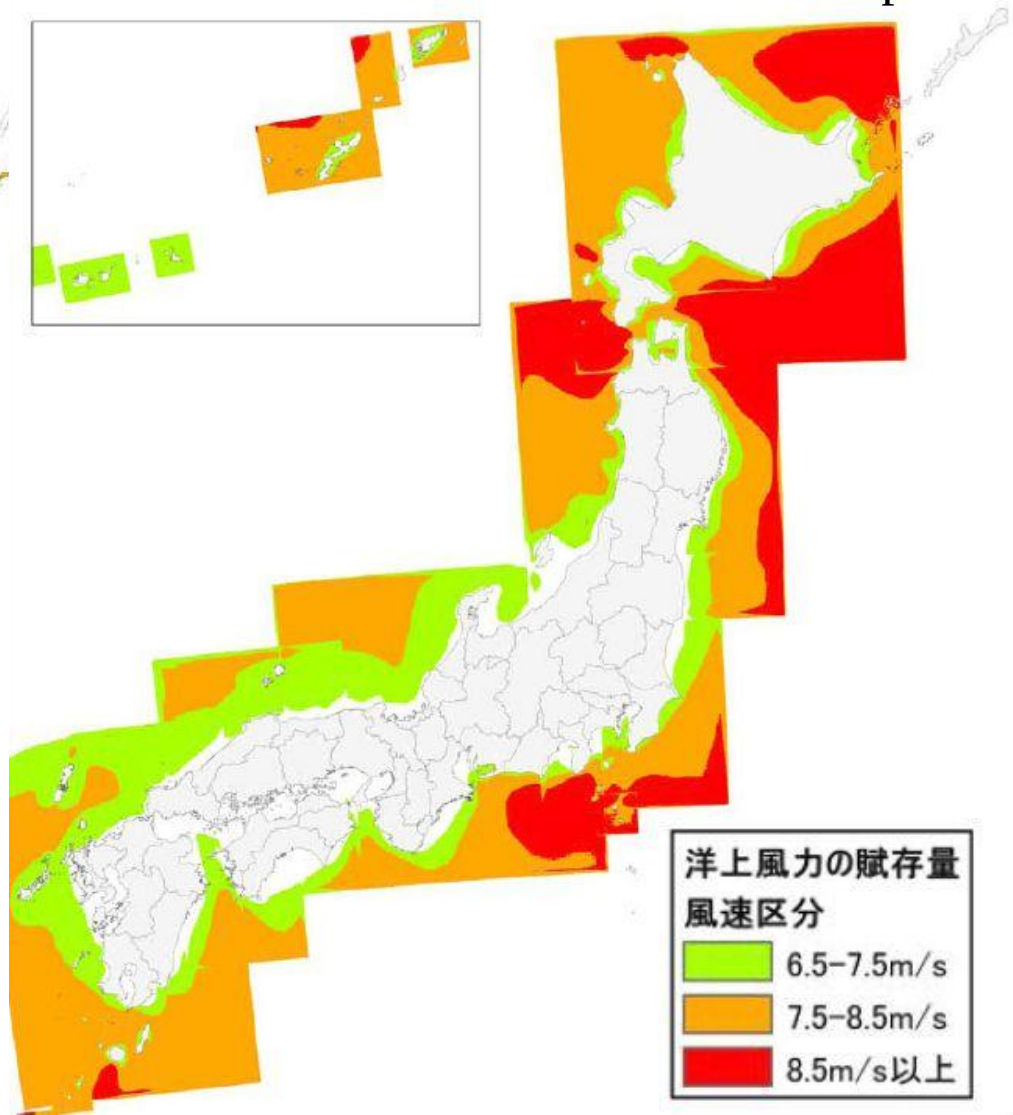
Scale model of Spar type: Prof. Utsunomiya in Kyoto Uni. , Toda-Kensetsu, etc

After the Disaster on March 11, 2011

Potential Map of Wind Power in Japan

- Report of investigation for renewable energy in Ministry of Environment in 2011
- 280 GW for onshore, 1600 GW for offshore as potential value
- 273 GW for onshore , 141 GW for offshore under some scenario such as half-price





1. Japan's current situation and challenges of Wind Power

Wind power

- Total wind power site : 479 (less than 5 wind tower : 393)*

  *Almost all of wind power site are small.

- Many sites are unprofitable due to higher than expected maintenance costs as a result of Japan's unique site conditions, e.g. strong mountain ridge turbulence

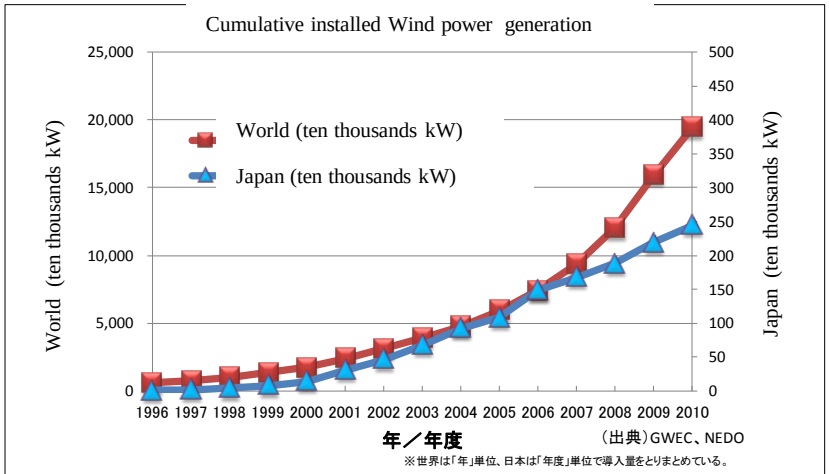
→ Site conditions are key to profitable projects / Significant need for deregulation and reduced grid integration barriers

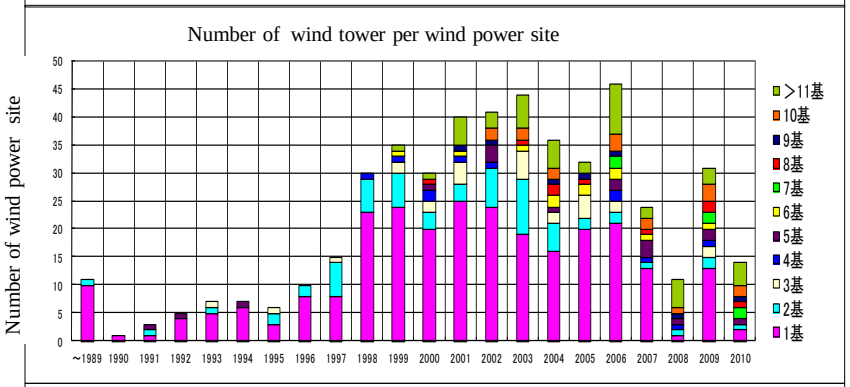
Offshore Wind power

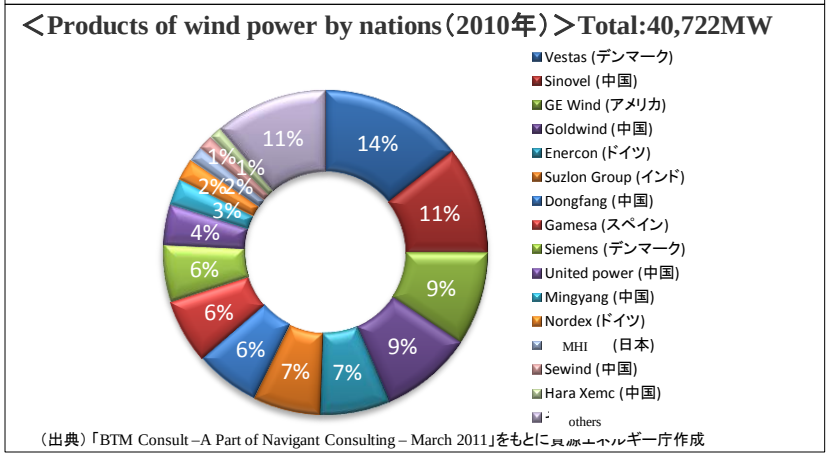
- Commercialization of offshore wind is expected in the near future
  -Current cost is high, but there are significant offshore wind resources
- Europe- many shallow-water sea areas suited to offshore fixed bottom
  Japan- shallow water areas are relatively small, therefore floating offshore wind power will be necessary, even when including the increased grid connection cost
- Based on a request from the Fukushima Prefecture, METI will demonstrate the world's largest scale level "floating offshore wind power" as five-year plan

Challenges

- Lightning protection & wind forecasting & control technology development tailored to Japan to increase capacity utilization and cost reduction
- Regulatory reform promoting large-scale wind through: conversion of agricultural land, use of natural parks / national forests, & most importantly a regulatory landscape
- Measures are needed to promote: off-peak electricity storage, enhance & support grid connections







Source : METI, Japan

2. 0ffshore Wind Energy R&D Project ① （FY2008～FY2014）

Research and Development of Offshore Wind Power Generation Technology
（ FY2012 budget 5.2billion yen （FY2011 budget 3.73 billion yen）

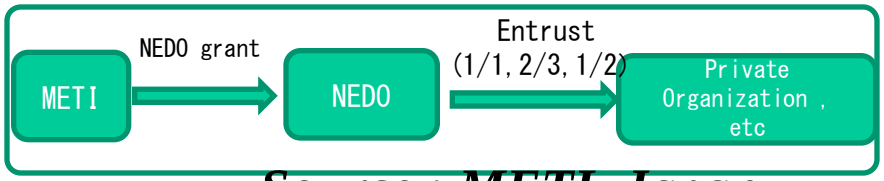
Contents

○ Domestic wind power generation reduce suitable sites by social acceptability issues such as noise and low frequency noise or landscape view concerns. In the future, large scale wind introduction to promote expansion of wind power needs to be deployed offshore.

○ R&D performed to establish offshore wind power technology suitable for Japan's meteorological and oceanographic conditions:
- ☞ Demonstrate wind observation/forecasting systems
- ☞ Demonstrate offshore fixed bottom wind power
- ☞ Demonstrate large (> 5MW) wind power systems
- ☞ Feasibility study for floating offshore wind power systems

○ Such R&D efforts will prove the safety, reliability and economic potential of offshore wind. The R&D will also accelerate the introduction of wind power in Japan, and assist the development a stronger domestic wind power industry resulting in greater international competitiveness

Conditions（applicant, subsidiary rate, etc.）



Source : METI, Japan

Image of project

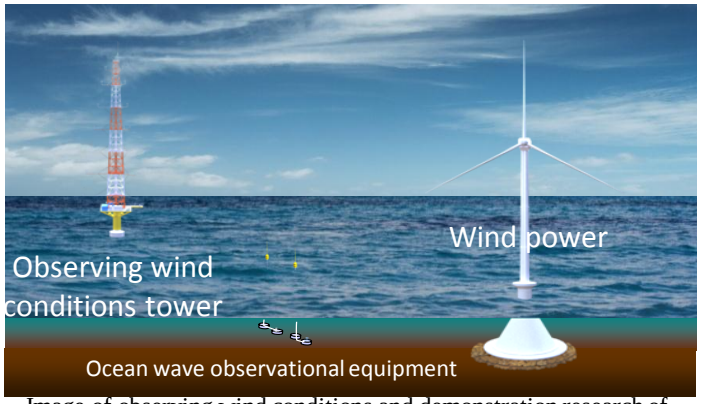


Image of observing wind conditions and demonstration research of offshore fixed bottom wind power
（provision：TEPCO, Tokyo Univ. , Kajima corporation）

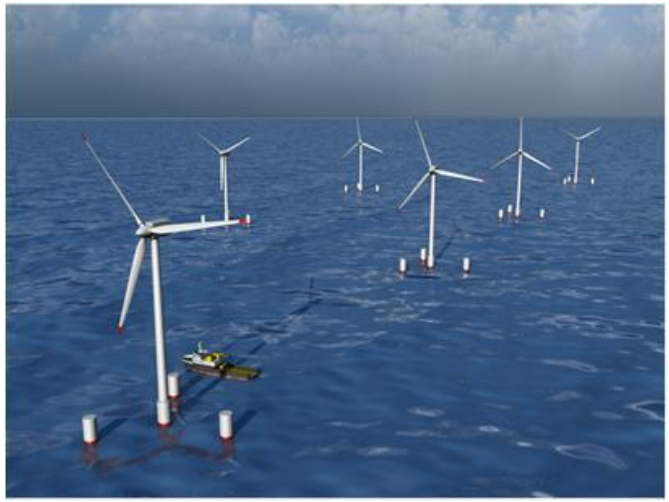


Image of floating offshore wind power
（provision：MES, Tokyo Univ., TEPCO）

3. Offshore Wind Energy R&D Project ② （FY2011～FY2015）

Floating offshore wind farm demonstration project
（FY2011 3rd supplementary budget：12.5 billion yen）

Contents of project

Summary / Purpose

○Affected areas in the east , in particular, Fukushima, are recovering from the earthquake damage. These areas are expected to provide large scale job creation due to accumulation of industries focused on renewable energy.

○This project will clarify the safety, reliability and economic potential of floating offshore wind by demonstration and experiments of the world's largest level floating offshore wind power generation system off the coast of Fukushima prefecture.

○After the completion of this project, This project is sought to make a new power generation business through the development of equipment as a result of this project.
By doing so, we aim to make a Japan a hub of wind power and contribute to the industrial revival in Fukushima

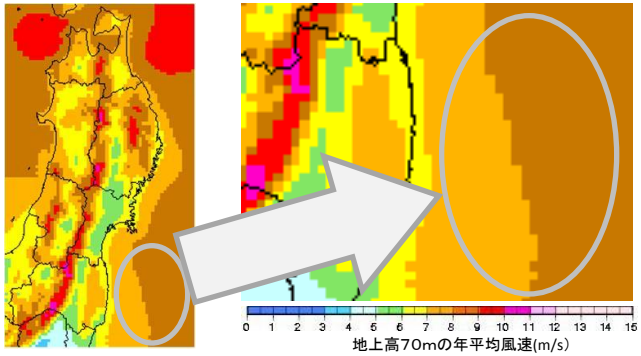
Conditions（applicant, subsidiary rate, etc.）

METI → Entrust → Private Organization , etc

Source : METI, Japan

Image of project

○Demonstration area : offshore of Fukushima Prefecture
○Such areas as well as a better wind conditions, are expected to take advantage of the former facilities of the offshore gas field, already being developed or currently in not use, offshore areas of Fukushima Prefecture are favorable.



Demonstration assumed area


Image of floating offshore wind power
（provision：MES, Tokyo Univ., TEPCO）

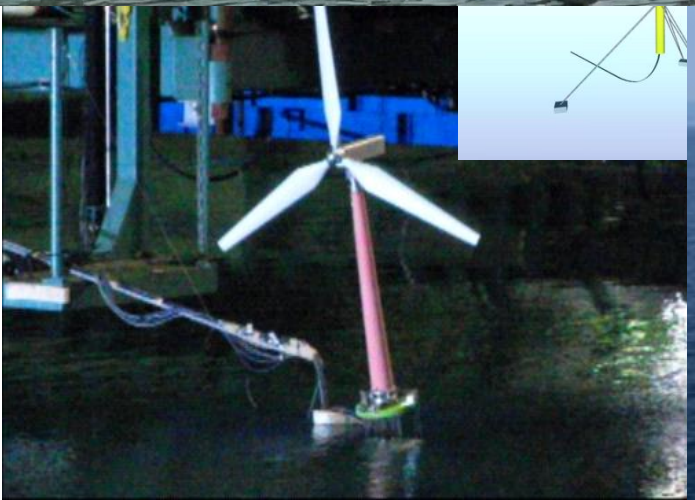
Floating offshore wind turbine demonstration project

- Objective: demonstrating the first full-scale floating offshore wind turbine in Japan
- Duration: FY2010-2015
- Contractors: Toda Corp., Kyoto Univ., Fuji Heavy Industries (FHI), Fuyo Ocean Development & Engineering, National Maritime Research Institute (NMRI), and cooperative organisations

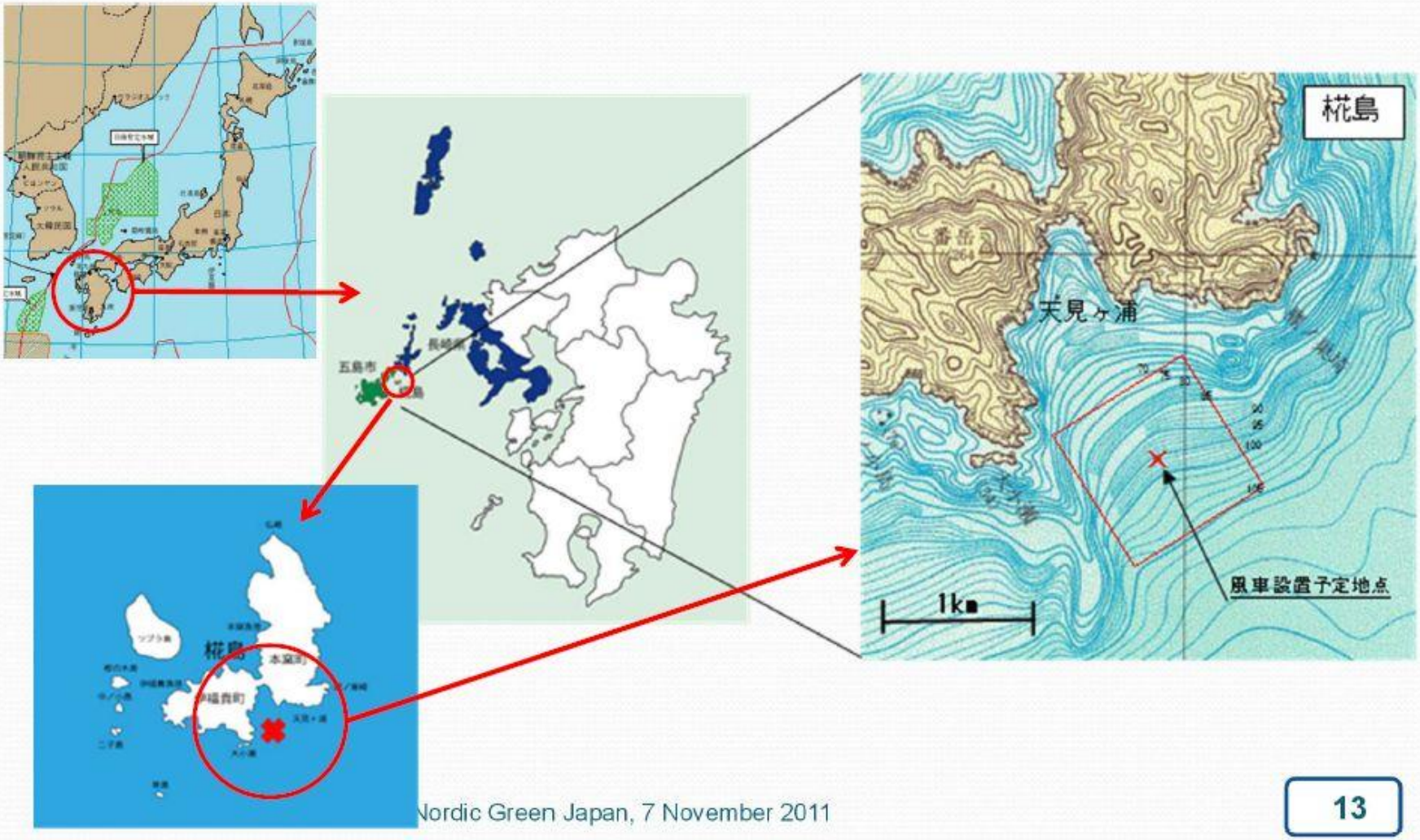
Source : MOE, Japan

Floating type of offshore by Ministry of Environment (MOE)

Source : MOE and Kyoto University, Japan



Demonstration site – Kabashima Island



Source : MOE, Japan

FIT for Wind :Proposal by Arakawa in 2010

【1】Onshore Wind

◎<u>20Yen/kWh</u>

- Penetration of wind power by large quantities
- Primary connection of wind to the electrical grid without line-off and storage battery
- Social acceptance before the installation of large wind turbines
- Interconnection of electrical grids between areas such as Tokyo, Tohoku and Hokkaido in order to develop large amount of wind power in rich area of wind resources

【2】Offshore Wind

◎<u>1.5 times of price against onshore（30Yen/kWh）</u>

- Large incentive of offshore wind
- Cooperative project with fishermen and persons in local community
- Development from fixed bottom type in shallow water to floating type in deep water
- Future plan of super electrical grid of sea for interconnection between areas

Concluding Remarks

For Onshore Wind Power

- Social acceptance is essential to avoid the influence of infrasound, landscape, bird-strike and so on.
- Primary grid connection of wind power is important with the electric power company using the connections with other areas.

For Offshore Wind Power

- Offshore wind power has large potential due to the huge area of ocean around Japanese island of EEZ 6th.
- Deep offshore system will be a key technology for future development of wind power and recovery from the disaster.
- Fisherman's right will be reasonably taken into account for cooperating with developer instead of compensation.
- Penetration of wind power in Japan is important, not the research and technology.