Wind Power Development in Japan

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1. Recent Situation in Japan

2. Windturbines withstood the Earthquake

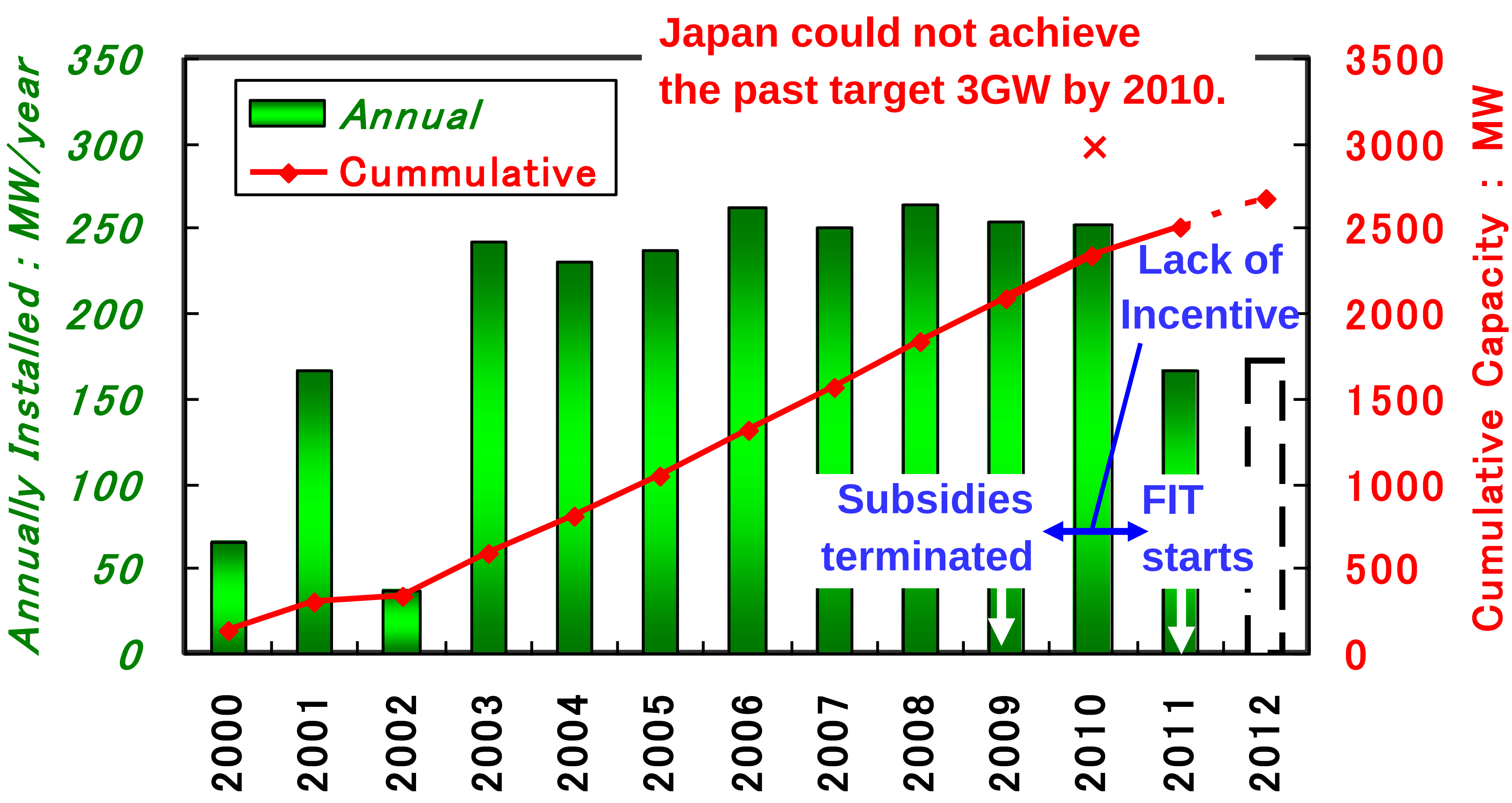
3. Energy Policy is changing in Japan

4. Offshore windpower development

Wind Power Generation in Japan

Latest wind Power Statistics in Japan (at the end of 2011)

- Total installed wind generation : 2,501MW, 1,832 units
- New wind generation installed : 167 MW / year
- Total electric output from wind : 4246 GWh / year
- Wind generation share of national electric demand : 0.5 %



Ref: Japan Wind Power Association

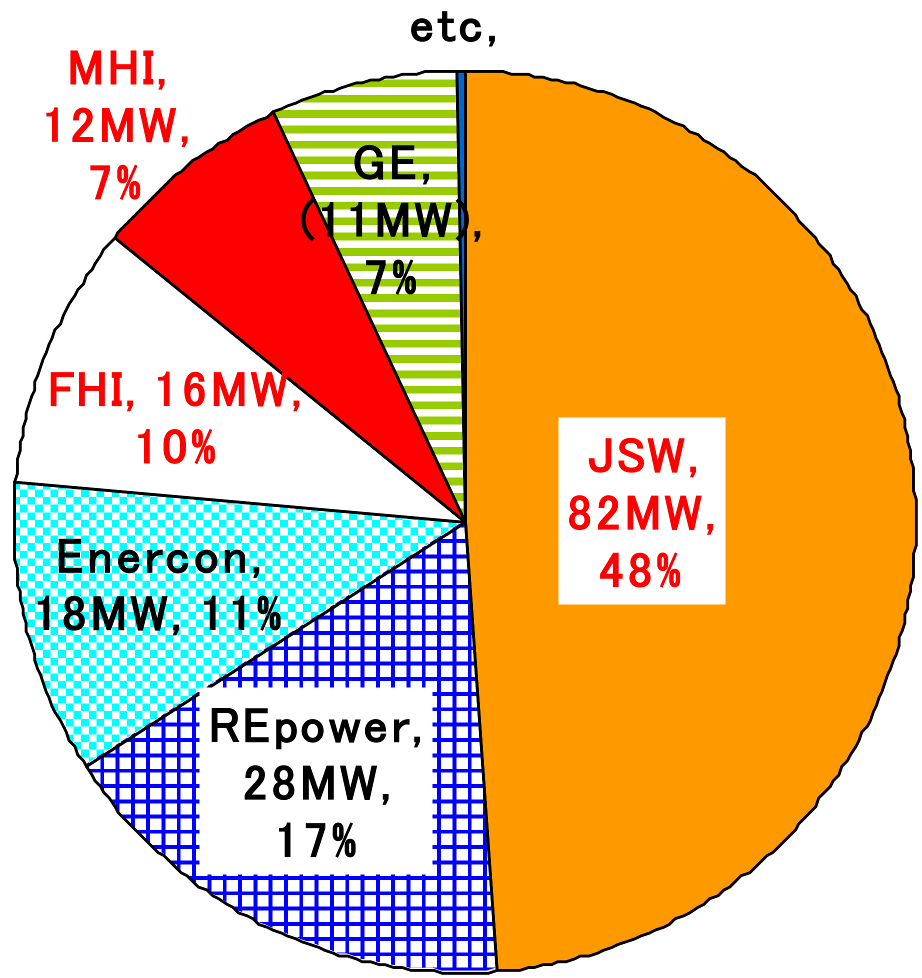
Domestic Manufactures get Major market Share

3 Japanese Domestic WTG manufacturers
- Japan Steel Works (JSW)
- Fuji Heavy Industries (FHI)
- Mitsubishi Heavy Industries (MHI)

They got 66% Japanese Market share in 2011.

Note: GE's 11MW is deregulation for past installed turbines

Japanese WTG Market Share in 2011



Recent Windfarm in Japan

Name: Kunimiyama Windfarm
Owner: Eurus Energy Japan
Location : Southern part of Japan
Start Operation: Mar. 2011
Output: 30 MW
WTG: JSW J82 2MW ×15 units

Recent Windfarm in Japan

Name: Omaezaki Windfarm
Owner: Chubu Electric Company
Location : Mid of Japan
Start Operation: Jan. 2011
Output: 22 MW
WTG: FHI SUBARU80 2MW ×11 units

Recent Windfarm in Japan

Name: Fukura Windfarm
Owner: Nihonkai Hatsuden Co.
Location : Coast side of Japan Sea, Mid of Japan
Start Operation: Feb. 2011
Output: 21.6 MW
WTG: MWT92/2.4 2.4MW × 9 units

Offshore Windpower Projects in Japan

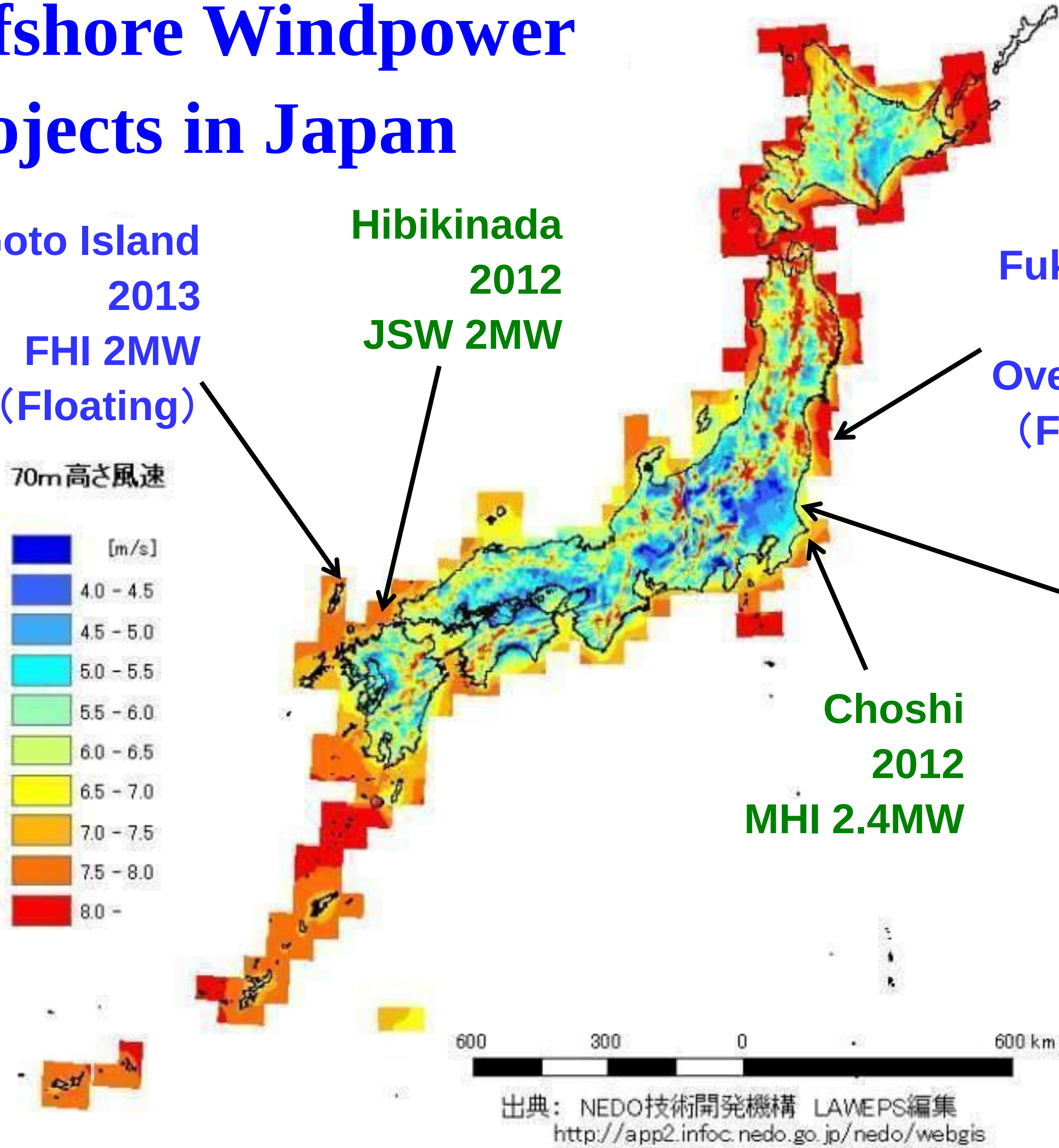
Goto Island
2013
FHI 2MW
（Floating）

Hibikinada
2012
JSW 2MW

Fukushima
2013～
Over 15MW
（Floating）

Kamisu
2010
FHI 2MW
X 7units

Choshi
2012
MHI 2.4MW



Kamisu WF become the 1st survivor of tsunami

Windpower Kamisu offshore windfarm is consisted by 7 SUBARU80/2.0 2MW WTGs. They are about 300km far from the epicenter.

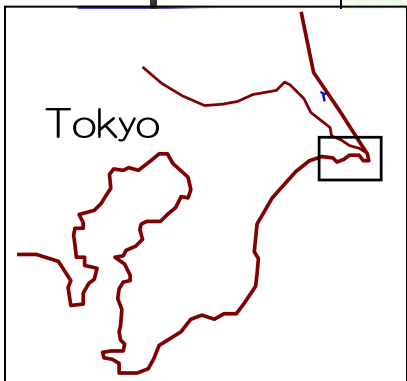
Shaking level was 5 plus and about 5 m height tsunami attacked the farm.

But turbines are safe and start operation again on 14.March.

Photo by Tokyo Shinbun

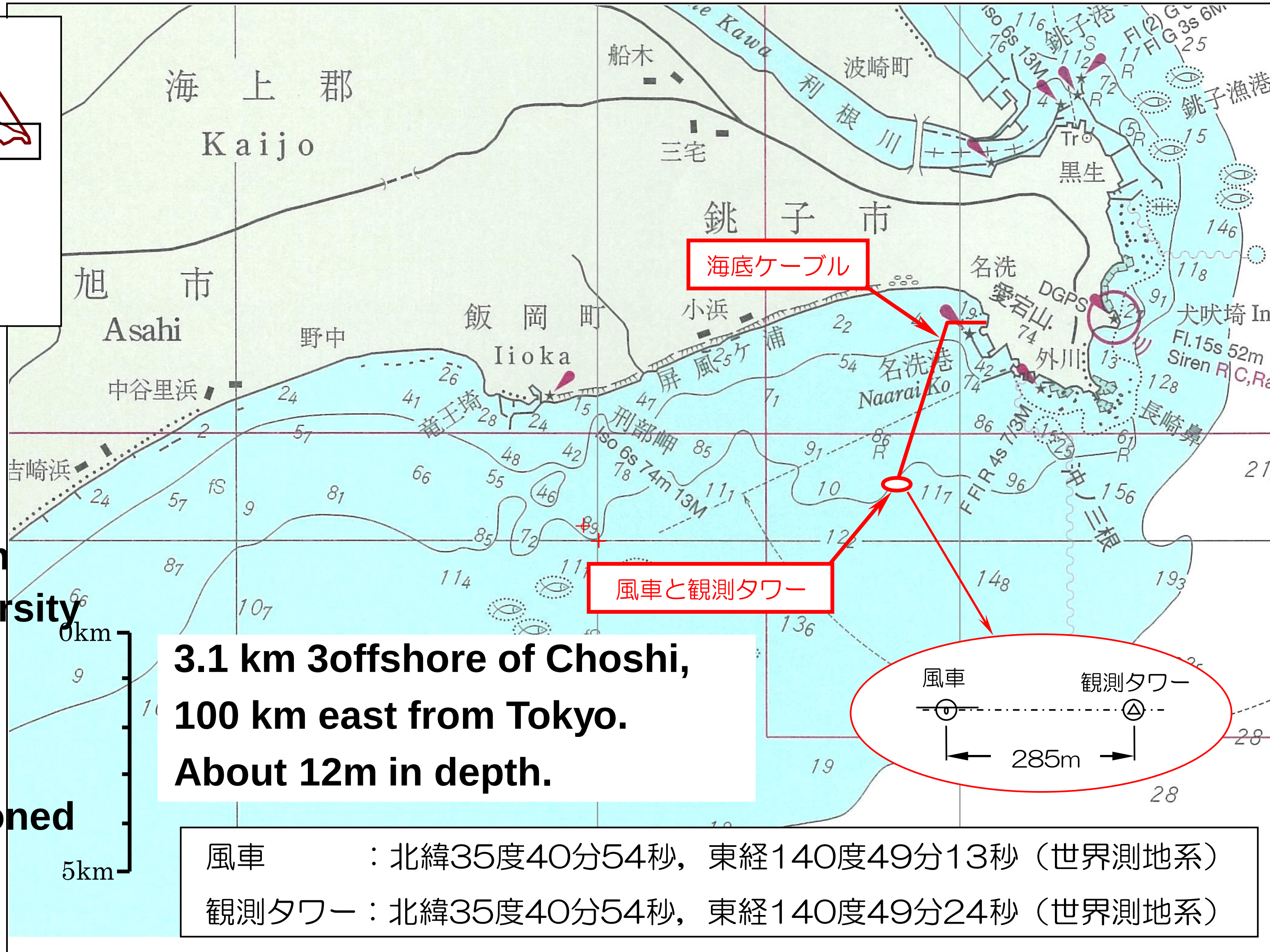
↑Many trashes are carried by tsunami under the turbines

Choshi Offshore Demonstration Project



Joint Project
- TEPCO
- MHI
- Kashima Construction
- Tokyo University

It is to install next summer.
It was postponed 1 year by the Earthquake.



3.1 km 3offshore of Choshi,
100 km east from Tokyo.
About 12m in depth.

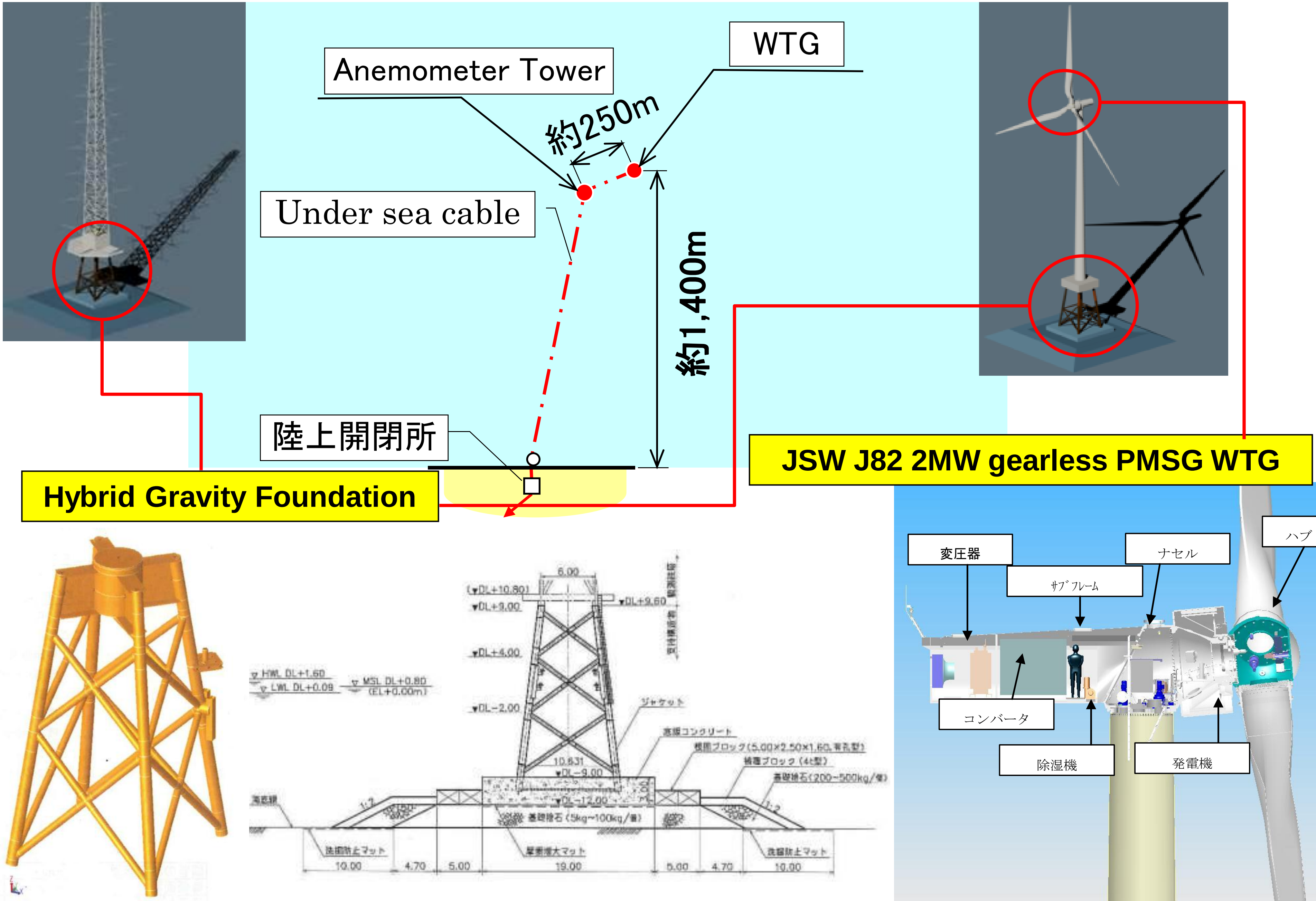
風車　　　：北緯35度40分54秒，東経140度49分13秒（世界測地系）
観測タワー：北緯35度40分54秒，東経140度49分24秒（世界測地系）

Choshi Offshore Demonstration Project

Hibikinada Offshore Demonstration Project

- ✓ **Offshore** : **約1.4 km**
- ✓ **Depth** : **約14 m**
- ✓ **Average Wind Speed** : **6.9 m/s**
- ✓ **Wave Height** : **6.7 m/s (Once a 50 years)**

Hibikinada Offshore Demonstration Project



MHI challenges to Offshore WTG

-Output : 7 MW Class

-Rotor Dia.: over 165m

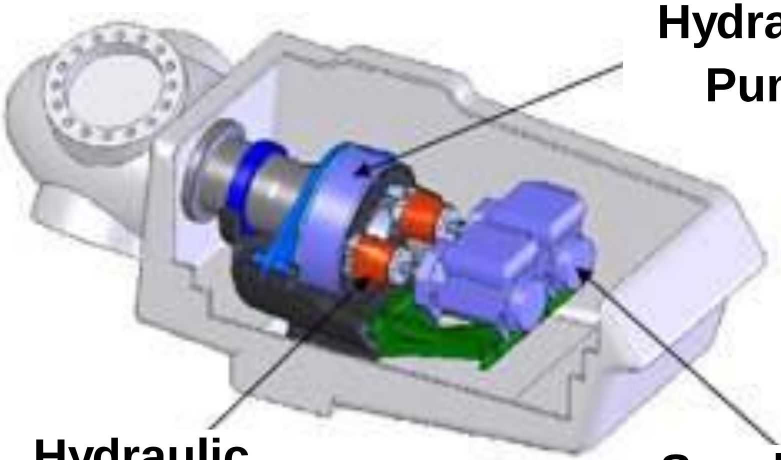
-Wind Class : IEC-Class S

-Drive Train : Hydraulic Type

-Generator : High Speed Synchronous Type

-Inverter : Not necessary

-1st Operation : 2013



Wind Power Potential in Japan

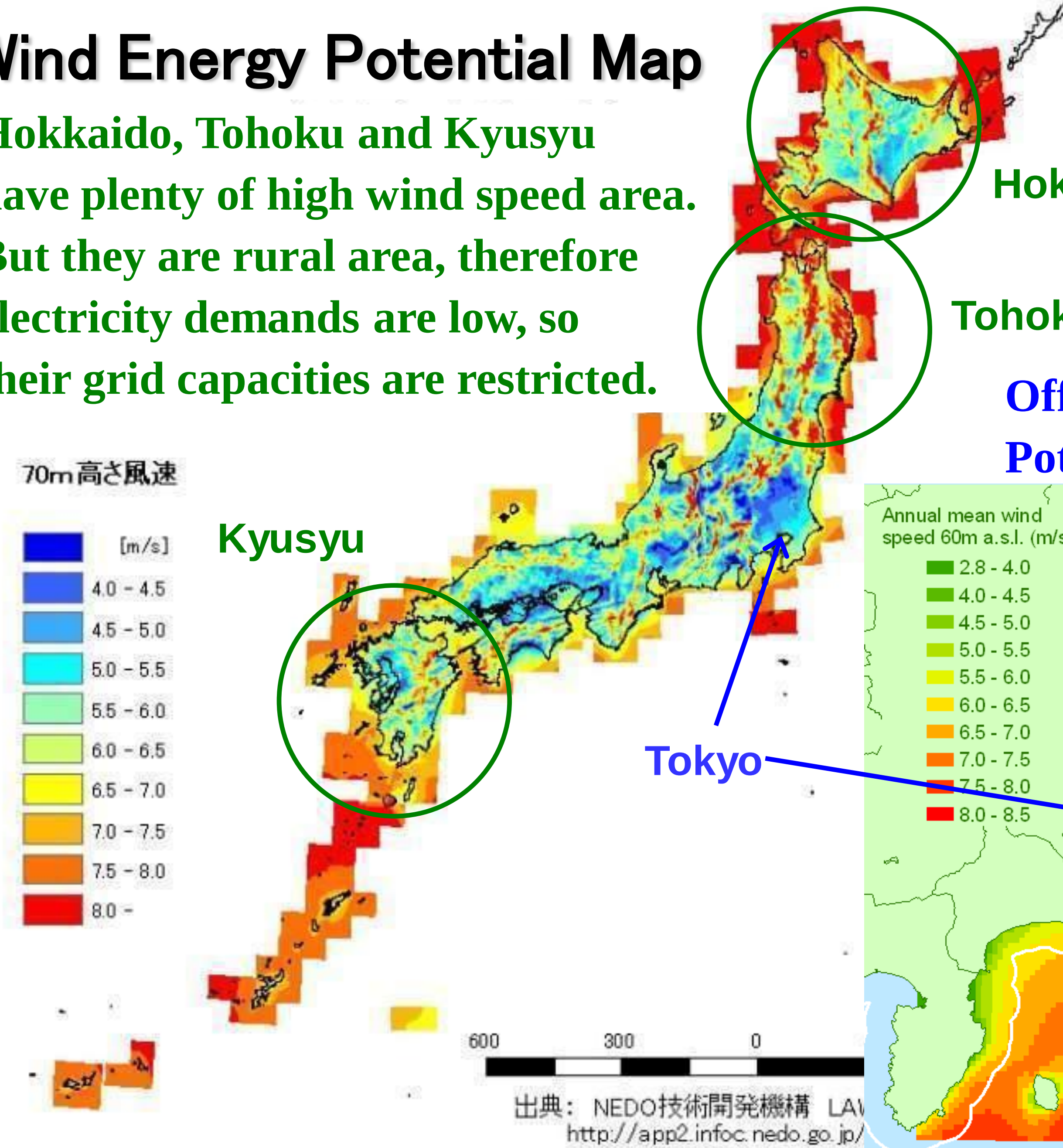
Two Ministries have published "Wind energy Resource in Japan" this spring.
Japan has enough potential including offshore windpower.

Ministry	Economy & Trade			Enviroment		
Kinds of WTG	Inland	Offshore	Floating	Inland	Offshore	Floating
1) Abundance (Without any restriction)	1550GW (5.5m/s>)	370GW (6.5m/s>)	1380GW (6.5m/s>)	1320GW (5.5m/s>)	-	-
2) Potential (Under some restriction)	290GW (5.5m/s>)	330GW (6.5m/s>)	1170GW (6.5m/s>)	280GW (5.5m/s>)	1570GW (6.5m/s>)	
3) Grid capacity (Specifide by elecrtric companies)	About 10GW			-	-	-
4) Cost Performance (IRR>8% at 20JPY/kWh,15years)	99GW	23GW	21GW	-	-	-
5) Social Acceptance 1 (Local governments intention)	52GW	9GW	8GW	-	-	-
6) Social Acceptance 2 (Residence intention)	39GW	6.8GW	6.3GW	-	-	-
7) FIT (20JPY/kWh,15years)	-	-	-	100GW	0.17GW	
8) Costdown Senalio (WTG 50%, Construction 20%)	-	-	-	270GW	140GW	
9) FIT + 33% Subsidies	-	-	-	200GW	120GW	

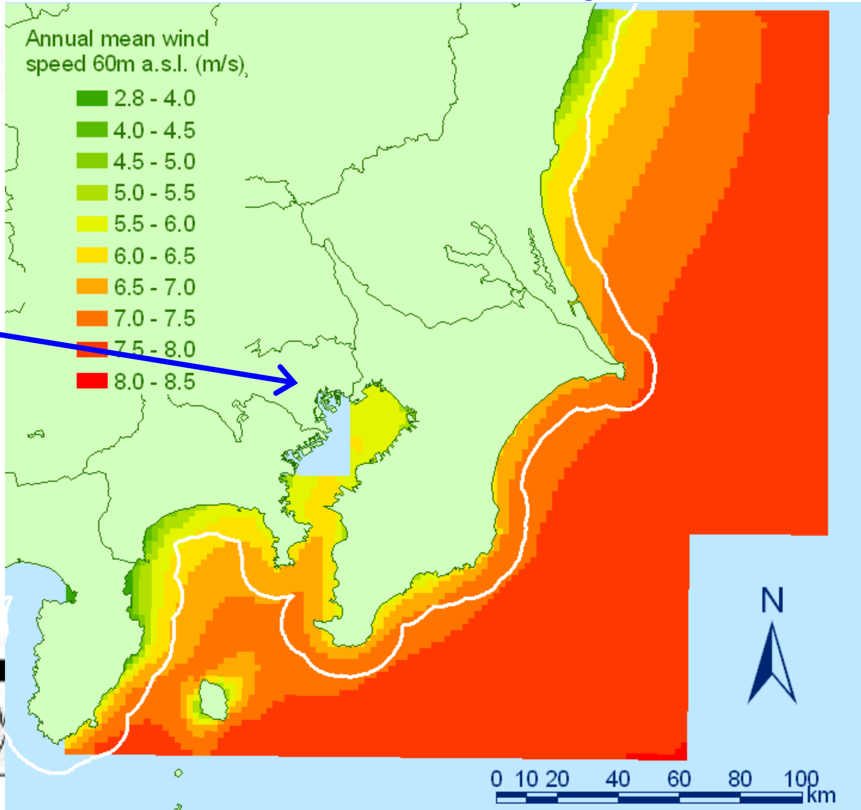
Summarized by New Energy Foundation

Wind Energy Potential Map

- Hokkaido, Tohoku and Kyusyu have plenty of high wind speed area.
- But they are rural area, therefore electricity demands are low, so their grid capacities are restricted.

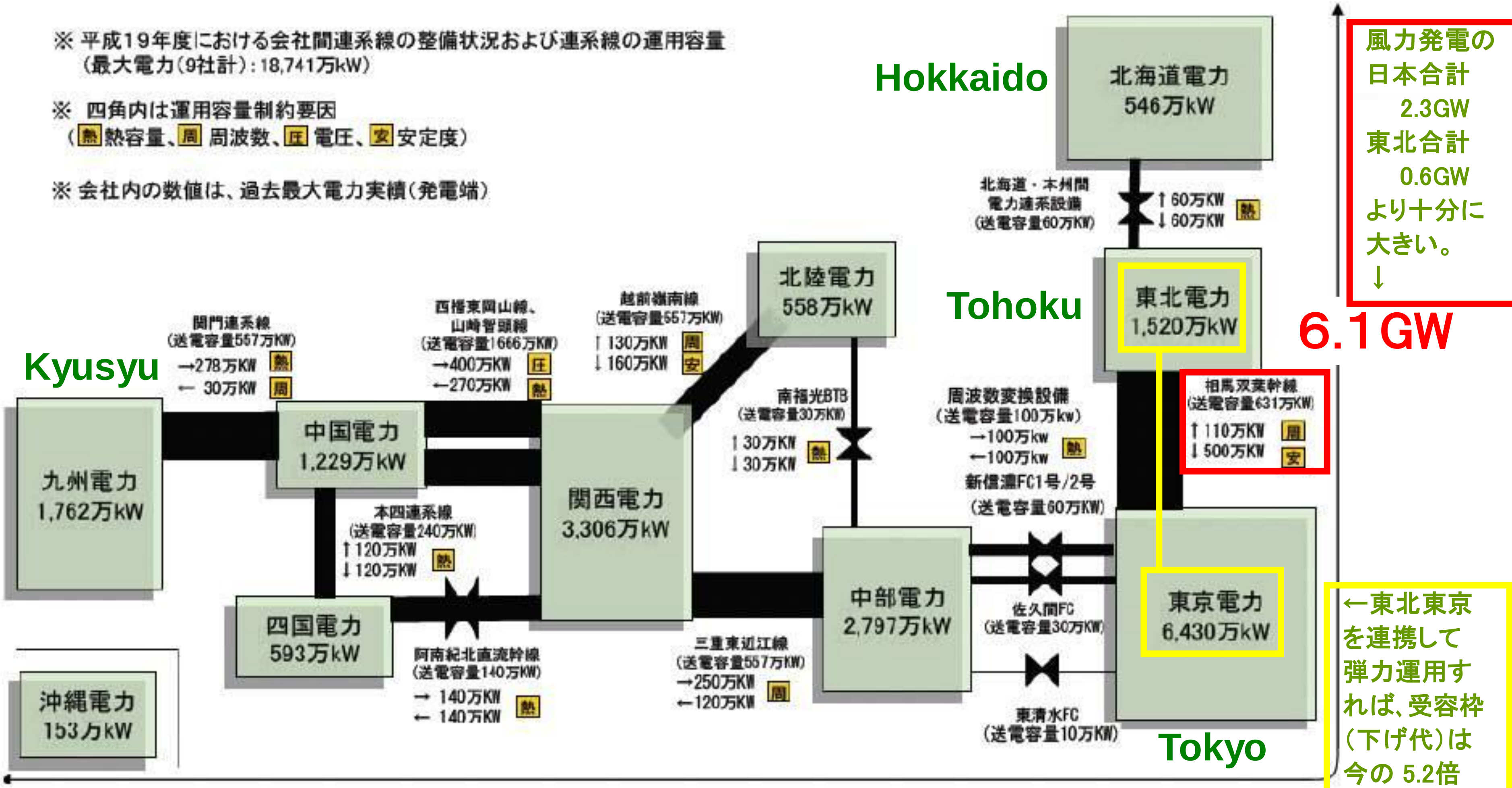


Offshore wind has large Potential near Tokyo.



10 Regional Electric Companies

図１　現状の地域電力会社間の連系線と運用容量



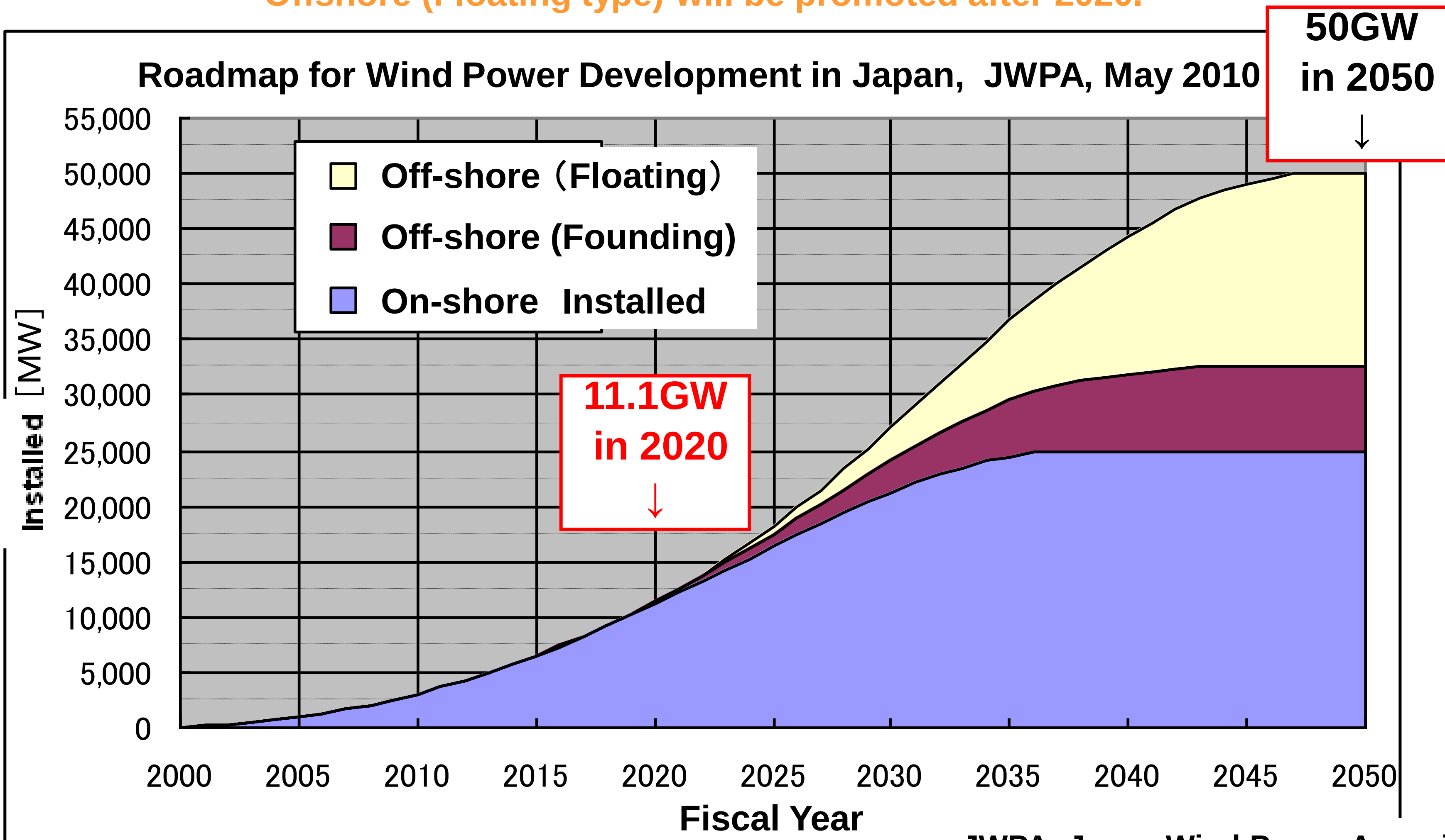
出所：「電力の安定供給と環境適合について」（第28回電気事業分科会資料）

次世代のエネルギー政策③
再生可能エネルギー普及の基盤となる透明性の高い広域送電網
日本総合研究所、2011年7月19日　より

JWPA's proposal to Japanese Government

- Wind power shall supply 10% electricity demand in Japan by 2050.
- Installed capacity shall be 11.1GW in 2020 and 50GW in 2050.

  50GW = On-shore 25GW + Off-shore 7.5GW + Floating 17.5GW
- Offshore (Founding type) will be promoted after 2015.
- Offshore (Floating type) will be promoted after 2020.



JWPA: Japan Wind Power Association

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Most of Wind tirbines in Japan have withstood the Earthquake.

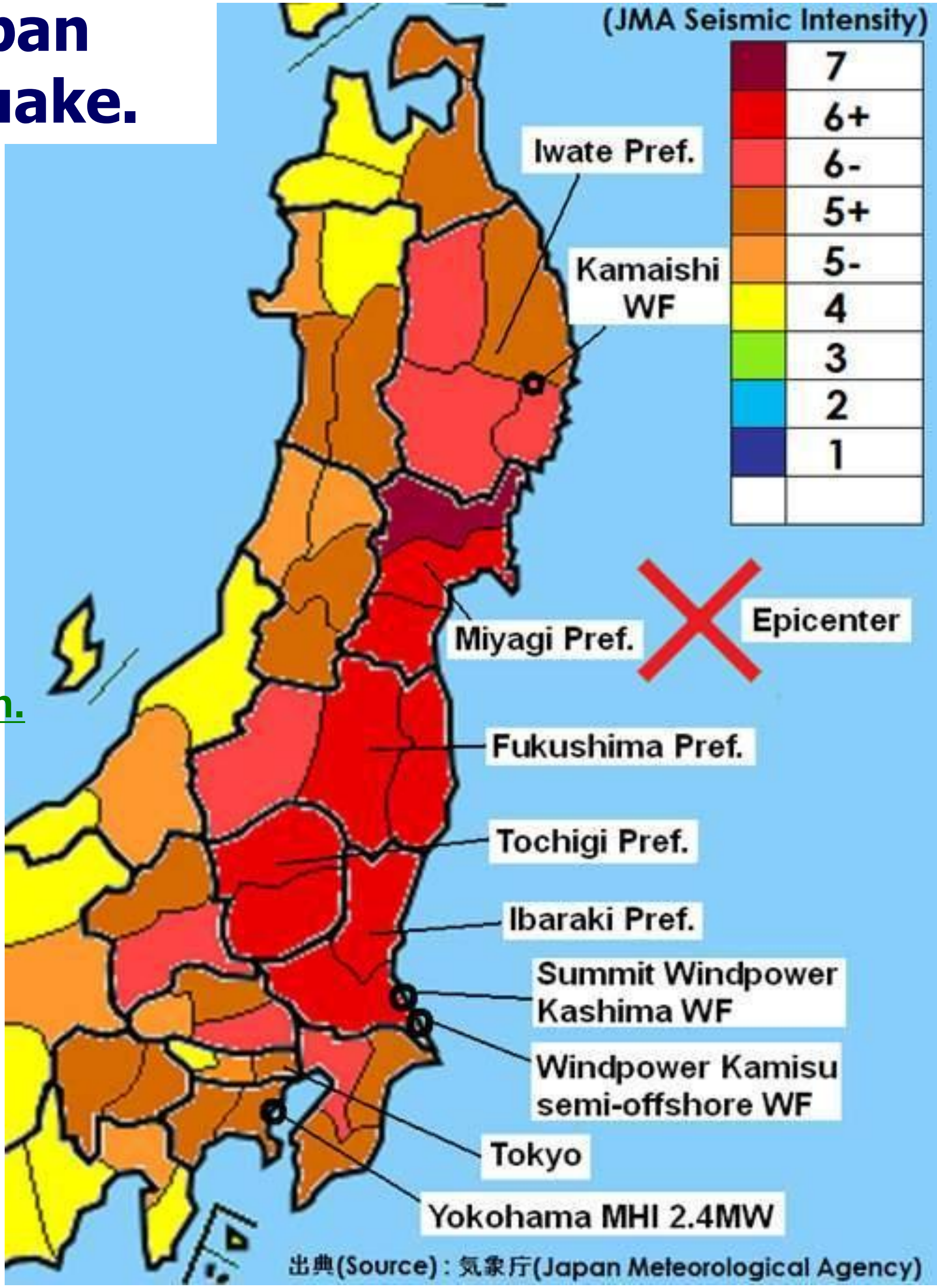
Kamaishi windfarm (1MW X 43 WTGs) is about 130km far from the epicenter.
This wind farm is the nearest one.
They are at safe against the Earthquake.

2 sites of 74 MW with 37 WTGs are within 30 km from Fukushima No.1.

1 WTG has leaned a little by liquefaction at Kashima. <u>This is the only 1 damage in Japan.</u>
Kamisu semi-offshore WF of 14 MW with 7 WTGs withstood about 5m height tsunami.
They locate 300km far from the epicenter.

Wind turbines in shaking level 6 prefectures

Prefecture	No. of sites	Capacity	No.of WTGs
Iwate	5	67.1 MW	62
Miyagi	0	0 MW	0
Fukushima	8	115.9 MW	66
Ibaraki	17	86.5 MW	55
Tochigi	5	0.8 MW	7
Total of 5 Pref	35	270.2 MW	190



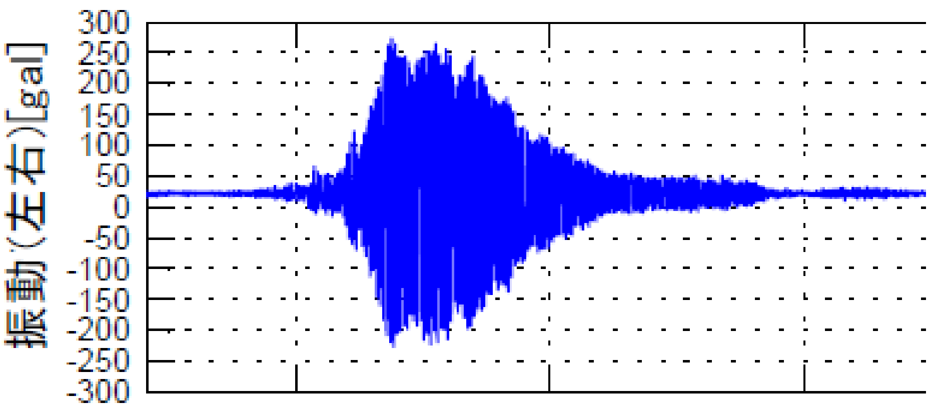
Only 1 WTG was damaged by liquefaction

1 WTG at Sumiit Windpower Kashima in Ibaraki Pref. about 300 km far from the epicenter, has been leaned a little by severe liquefaction. This windfarm is consisted by 10 Gamesa G80 2MW turbines, the other 9 turbines are in the normal condition.

Ref: Geotechnical Quick Report on the Kanto Plain Region during the March 11, 2011, Off Pacific Coast of Tohoku Earthquake, Japan Geotechnical Extreme Events Reconnaissance (GEER), April 5, 2011

About ¼ gravity shaked WTGs at 400km distance

About 1/4 gravity (280gal) was observed for several minutes at the vibration sensor fixed in the nacelle at 70m hub height in 2.4MW turbine at Yokohama, which is about 400 km far from the epicenter.



Second

1 Gravity = 981gal

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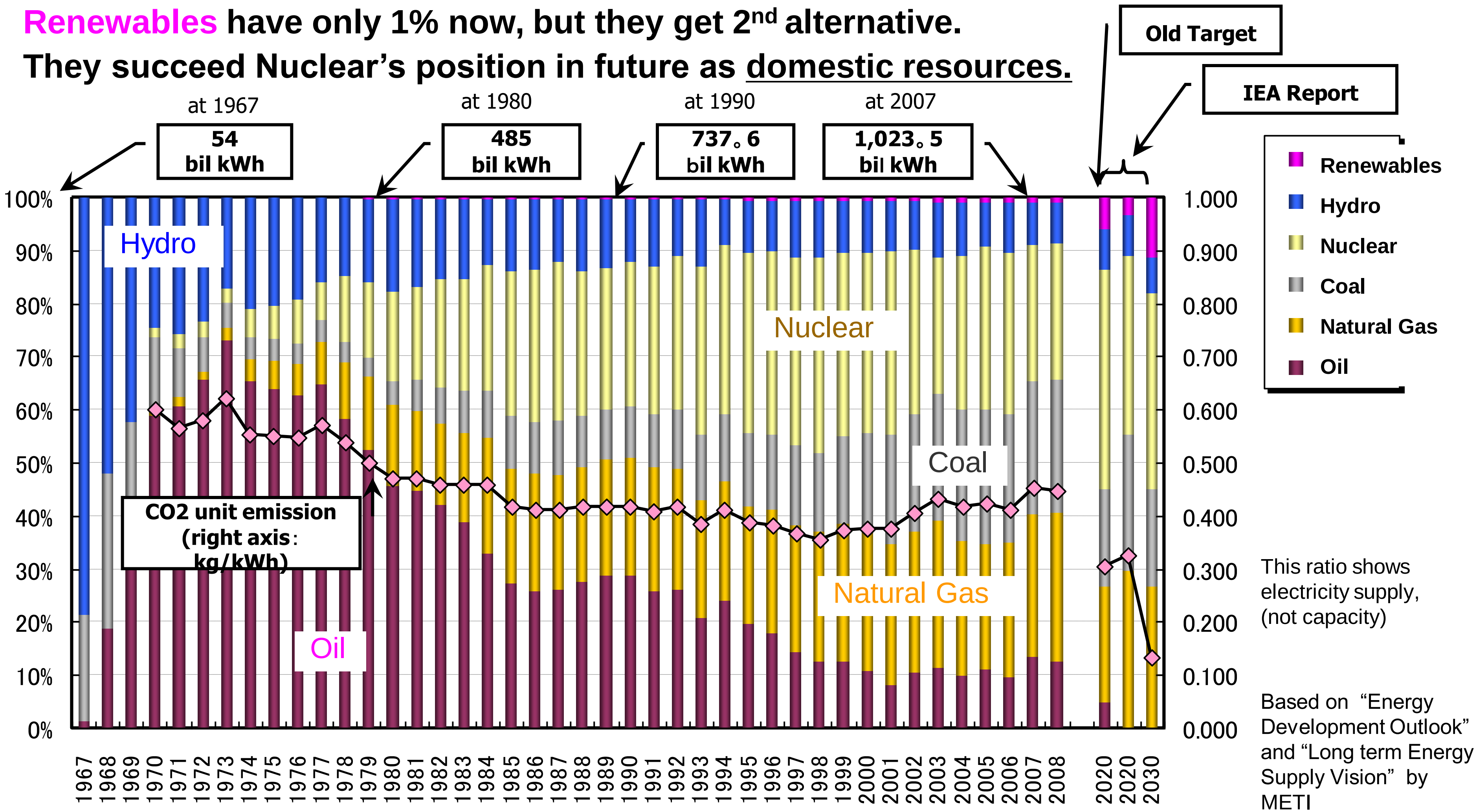
The Succession of Energy Source in Japan

- Just after WW II, Hydro acted main role in Japan. Then Oil firing fossil plants got major.
- 1973&78, Oil Shock has happened. It threatened Japanese Energy Security.
  Oil decreased 73%=>12%. Nuclear･Coal･Natural Gas increased to 25% each.
  Nuclear got semi-domestic energy resource position to keep Japanese Energy Security.
- After Fukushima, Natural Gas becomes the 1st alternative because it is cheap and speedy.
  Renewables have only 1% now, but they get 2nd alternative.
  They succeed Nuclear's position in future as domestic resources.



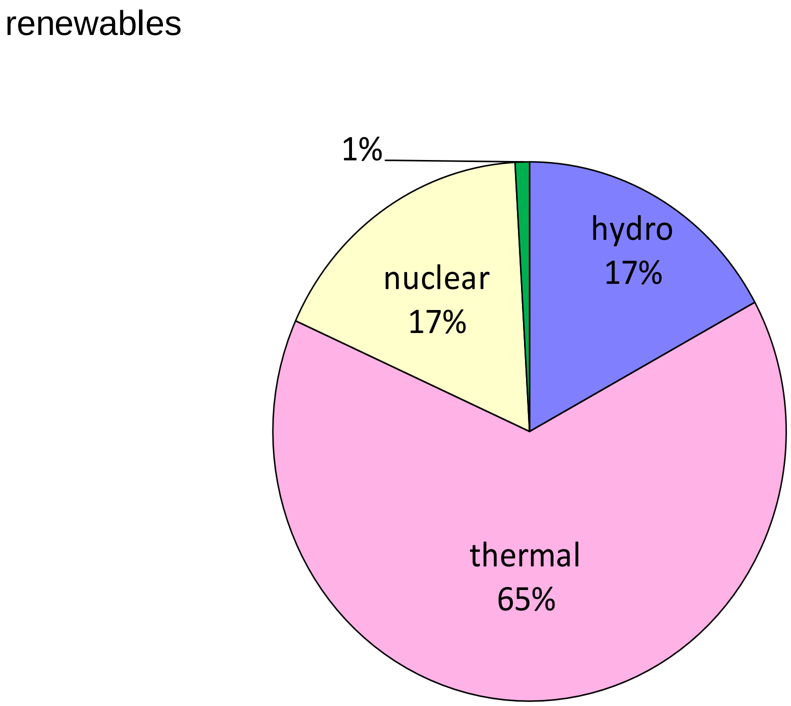
This ratio shows electricity supply, (not capacity)

Based on "Energy Development Outlook" and "Long term Energy Supply Vision" by METI

Power Supply in Japan before Fukushima

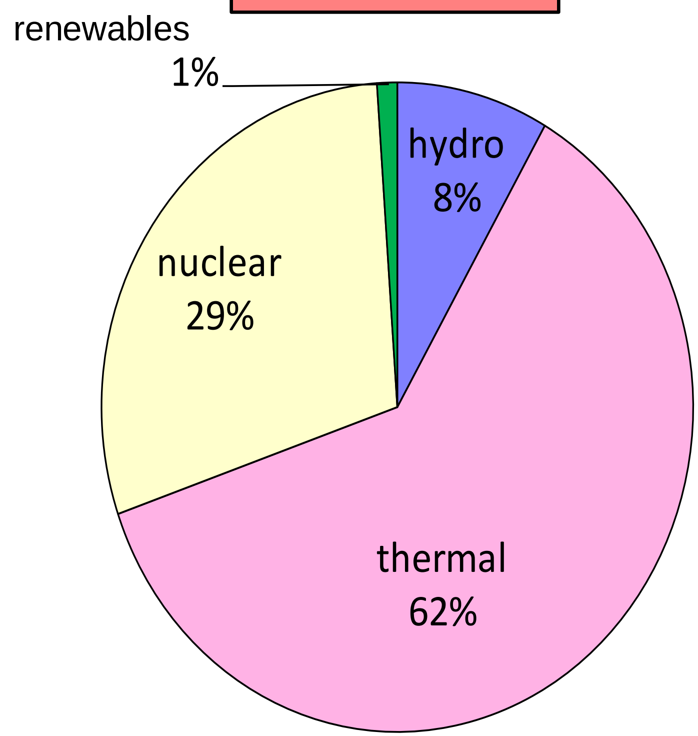
In all Japan's electricity supply, nuclear power accounts for about 20%(Installed Capacity) and 30%(Output).
Renewable energy accounts for under 1%(capacity/output).

Installed Capacity



Total Installed Capacity 281GW
(as of the end of May 2010)

Output

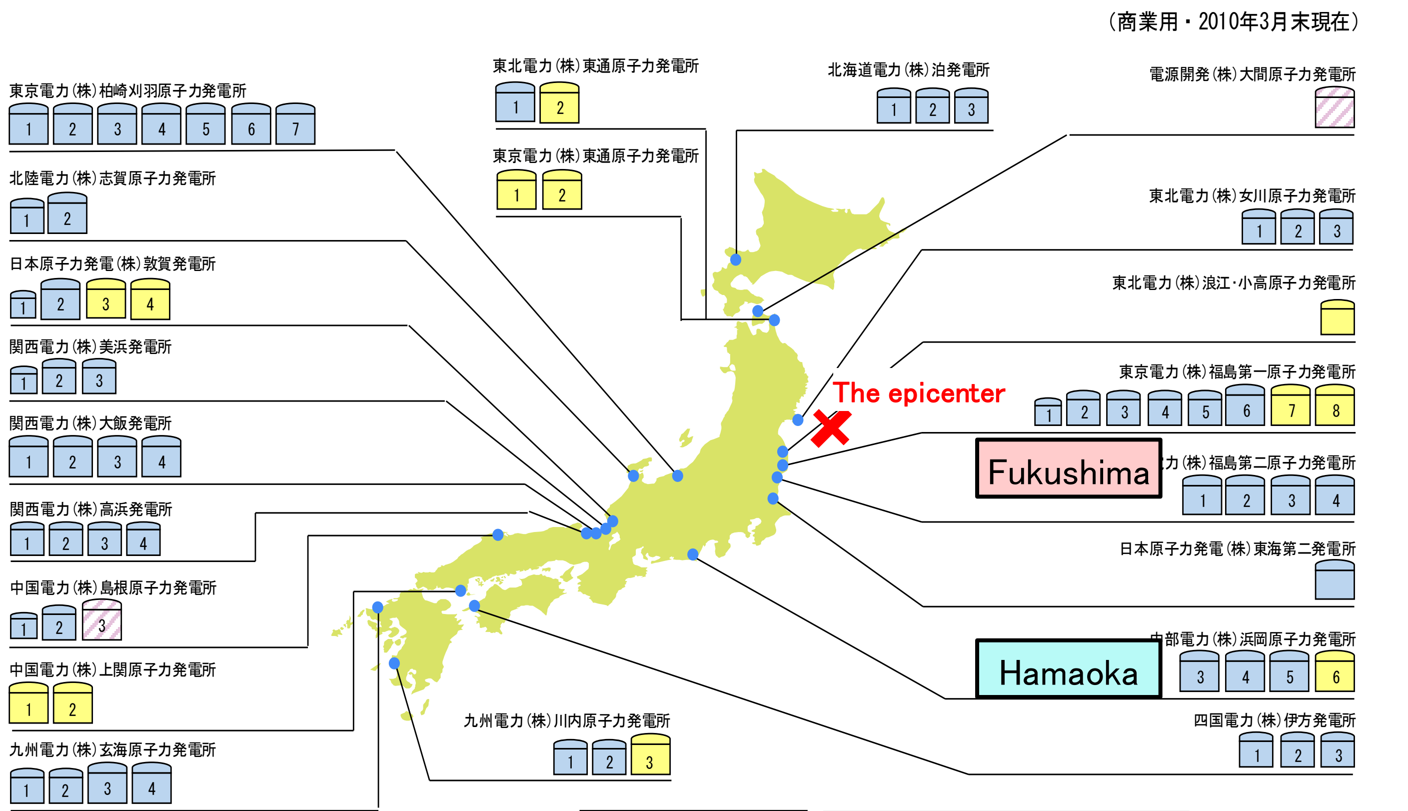


Total Output　957TWh
（2009 FY）

Power Supply in Japan before Fukushima

In Japan ,54 nuclear power plants（Total Capacity 49GW)are in commercial operation（as of the end of December 2010）

Nuclear Power Plants in Japan



	基　数	合計出力(万kW)
運　転　中	54	4884.7
建　設　中	2	275.6
着工準備中	12	1,655.2
合　　計	68	6,81

運転終了：日本原子力発電（株）東海発電所 1998.3.31／中部電力（株）浜岡原子力発電所1、2号機 2009.1.30

（Source：FEPC）

Post Fukushima

- National opinion changed from pro-nuclear to pro-renewables dramatically.
- New nuclear plant shall not be constructed.
- Existing nuclear plant are forced to stop, until they pass through proper ”Stress Tests”.
- Fossil power need importing fuels. That is not good for Japanese economy and job.

↓

- Renewable Energy will be promoted in Japan.
- New FIT law is the 1st step.

Problems in FIT and others

FIT

1) Prices are not decided yet.
   Appropriate profit is necessary for promotion.
2) Priority access to the grid is doubtful.
   There is a loophole which allows electric companies to refuse the connection.

Others

3) Regulations should be eased for promotion.
   a. "Legalized environmental Assessment" including bird strikes
      →3 years needed for approval
   b. Forest reserves

c. Farmlands restriction

d. Nature parks protection

e. Grid connection limitation

→Frequency fluctuation and capacity

4) Aggressive large and Long term target must be set for wind power development.

5) Technical development of wind turbines fitting to Japanese condition should be advanced.

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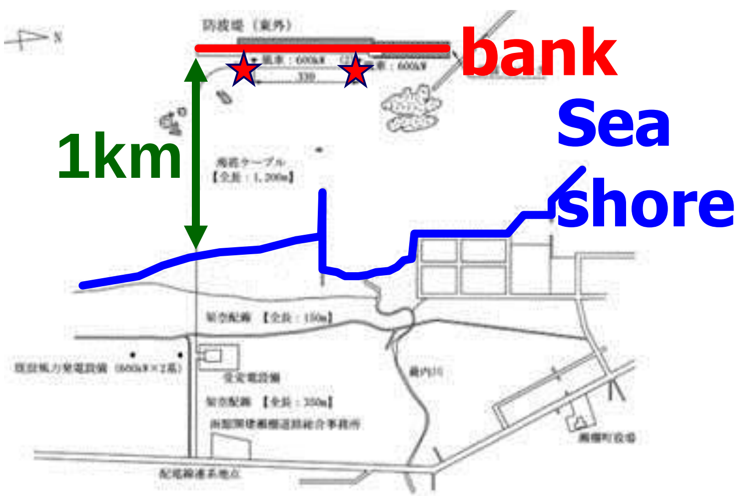
Offshore windpower in Japan

3 sites, 25.2MW with 14 offshore WTGs are operating.

Setana in Hokkaido Pref.
Start operation in Dec.2003.
Vestas 600kW × 2 WTGs



Sakata port in yamagata Pref.
Start operation in Jan.2004.
Vestas 2MW × 5 WTGs

Inland
3 WTGs

In the
Channel
5 WTGs

Ref: Summit Windpower Sakata

R&D Programs by METI

R&D for Offshore Windpower is getteing larger in Japan.

Ref: IEA Wind 2010 Annual Report, Chapter Japan

NEDO R&D Offshore Windpower Generation

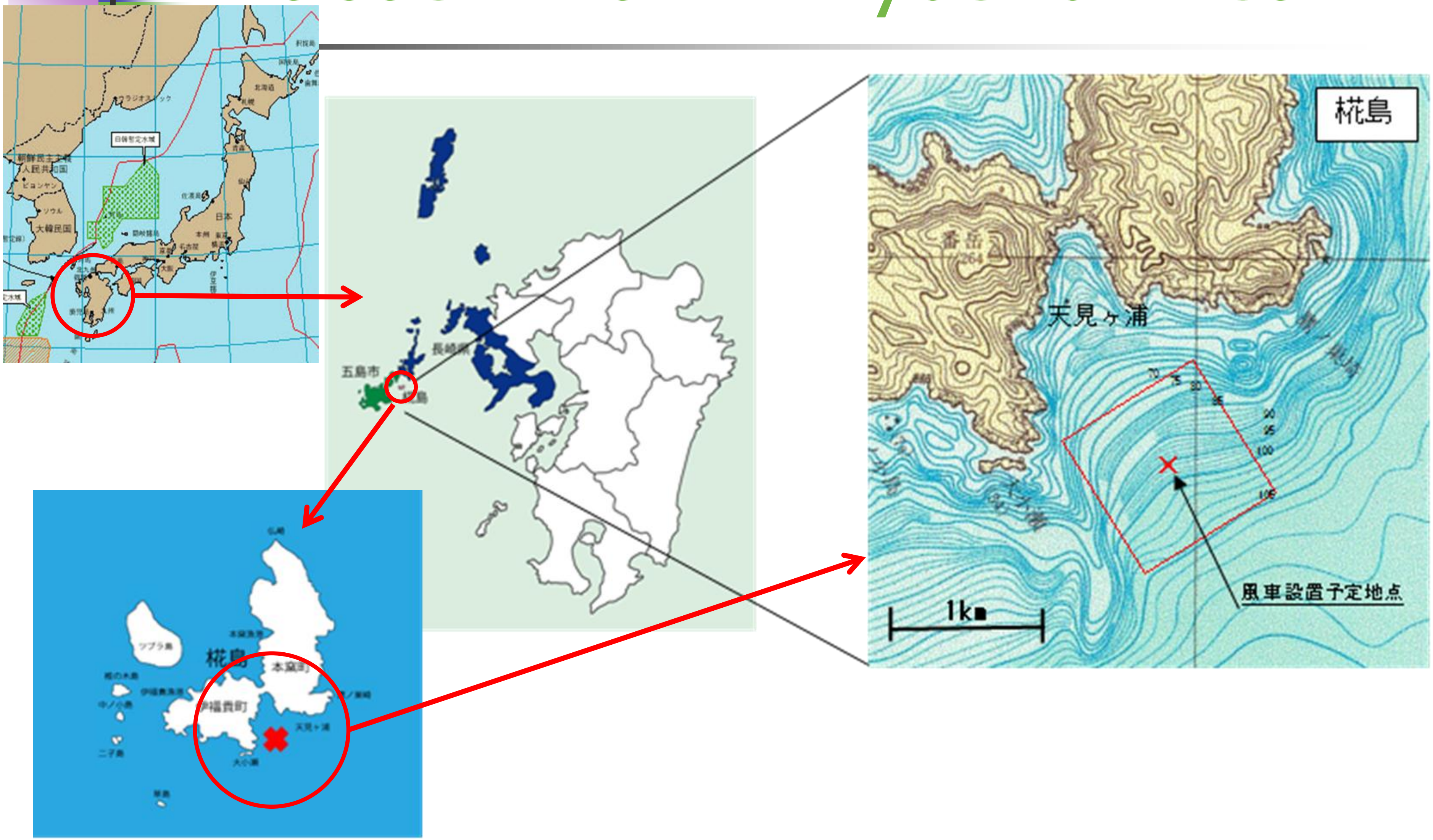
- Offshore Windturbine Demonstration PJ
  - 2.4MW at Choshi, 2MW at Hibikinada in 2012
- Offshore Windfarm Feasibility Study
  - 4 districts are chozen in 2011.
- Super Large Windturbine Development
- Ocean Energy Potential Study
- Floating Offshore Windturbine Basic study

Offshore Windturbine Demonstration National Project

Floating Offshore Wind Turbine Demonstration Project by Ministry of the Environment

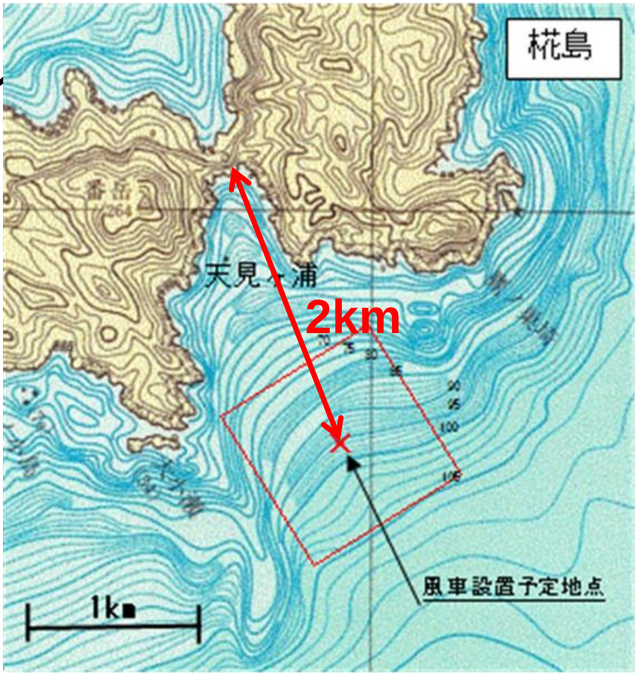
Fiscal year	2010	2011	2012	2013	2014	2015
Environmental study	**Planning**	**Environmental impact assessment and follow-up survey**				
100kW small-scale turbine	**Basic design**	**Detailed design & Construct.**	**Installation & Operation**	**Removal**		
2MW full-scale turbine		**Detailed design**	**Construction**	**Installation & Operation**		**Removal**
Misc.	**Selection of the site**					**Economic feasibility study**

Selected Site “Kabashima” in Kyushu Area

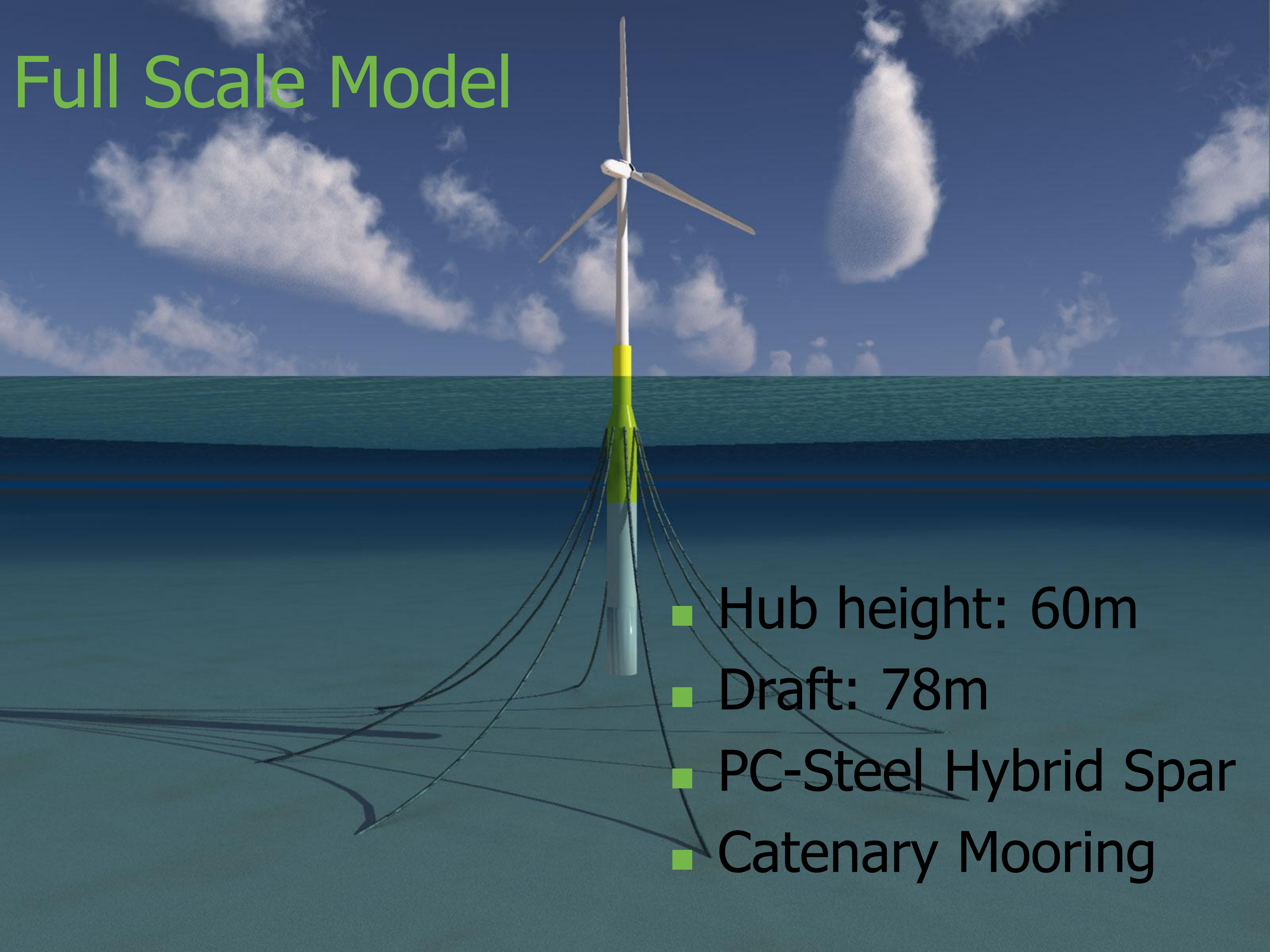


Major Environmental Conditions

- Water depth: 96m(LSWL)-99m(HSWL)
- Shortest distance from the shore: 1km
- Distance for marine cable: 2km
- $V_{annual\ average}$@60m: 7.5m
- V_{e50}@60m: 53.1m/s
- H_{s50}: 7.7m
- T_{s50}: 14sec
- Max Current: 0.96m/s



Full Scale Model



- Hub height: 60m
- Draft: 78m
- PC-Steel Hybrid Spar
- Catenary Mooring

Thank You for Hearing!

Sep.2011