Offshore wind in Japan

- Status, prospects and challenges-

Mitsuhiro Yamazaki

Deputy Director, NEDO Europe office in Paris

New Energy and Industrial Technology Development Organization(NEDO), Japan

New Energy and Industrial Technology Development Organization (NEDO)

Mission:

- Address energy and global environmental problems
- Develop Industrial technologies

Organization: Established in 1980; under the Ministry of Economy, Trade and Industry of the Government of Japan

Head Office: Kawasaki City, Japan

Personnel: Approximately 900

Budget: 130 Billion yen (≒ 1.08 Billion €) (FY2016)

Chairman: Mr. Kazuo Furukawa

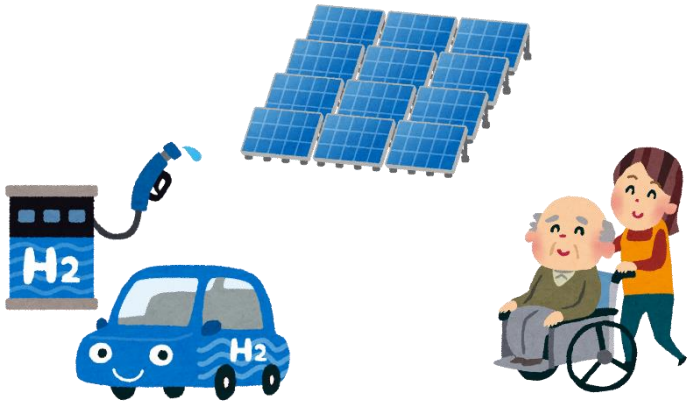
NEDO's Activities

NEDO supports
not only *Domestic R&D in Japan*
but also *International collaboration*

Because...

Open innovation

Breakthrough
in common social issues



NEDO's Science and Technology

Basic Research → **Technology Development** → **Demonstration**

Renewable energy

Energy conservation

Electronics /ICT

Materials/nanotech

Energy storage

Water treatment

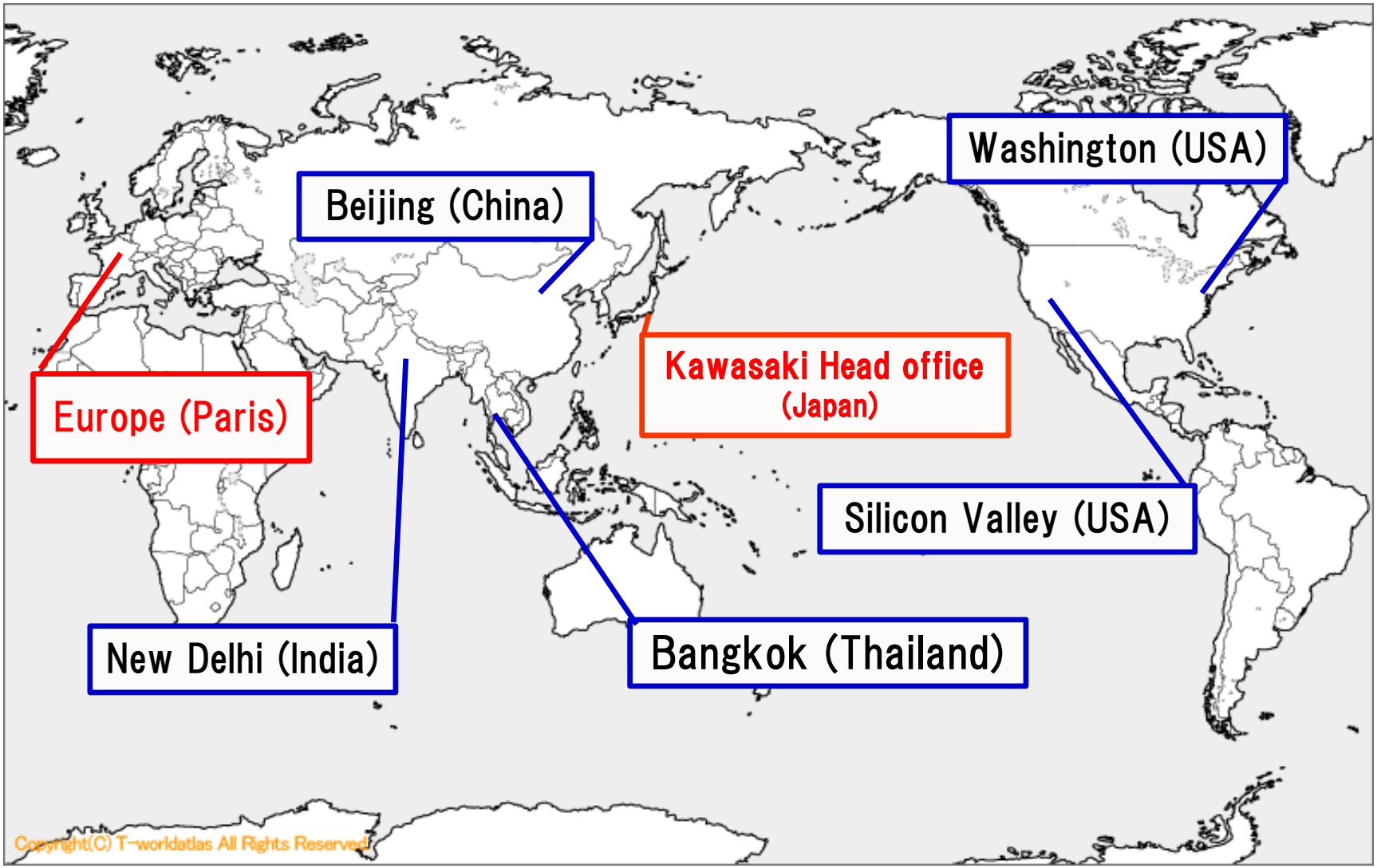
Smart community

Environment/ clean coal

Robotics

Bio/medical

NEDO Overseas Offices



Paris office cover on EU27 countries.

NEDO activity in Europe (Example)

Lyon (France)
Smart city applications for re-developed urban area

Speyer (Germany)
Establish the local energy production and consumption model smart community

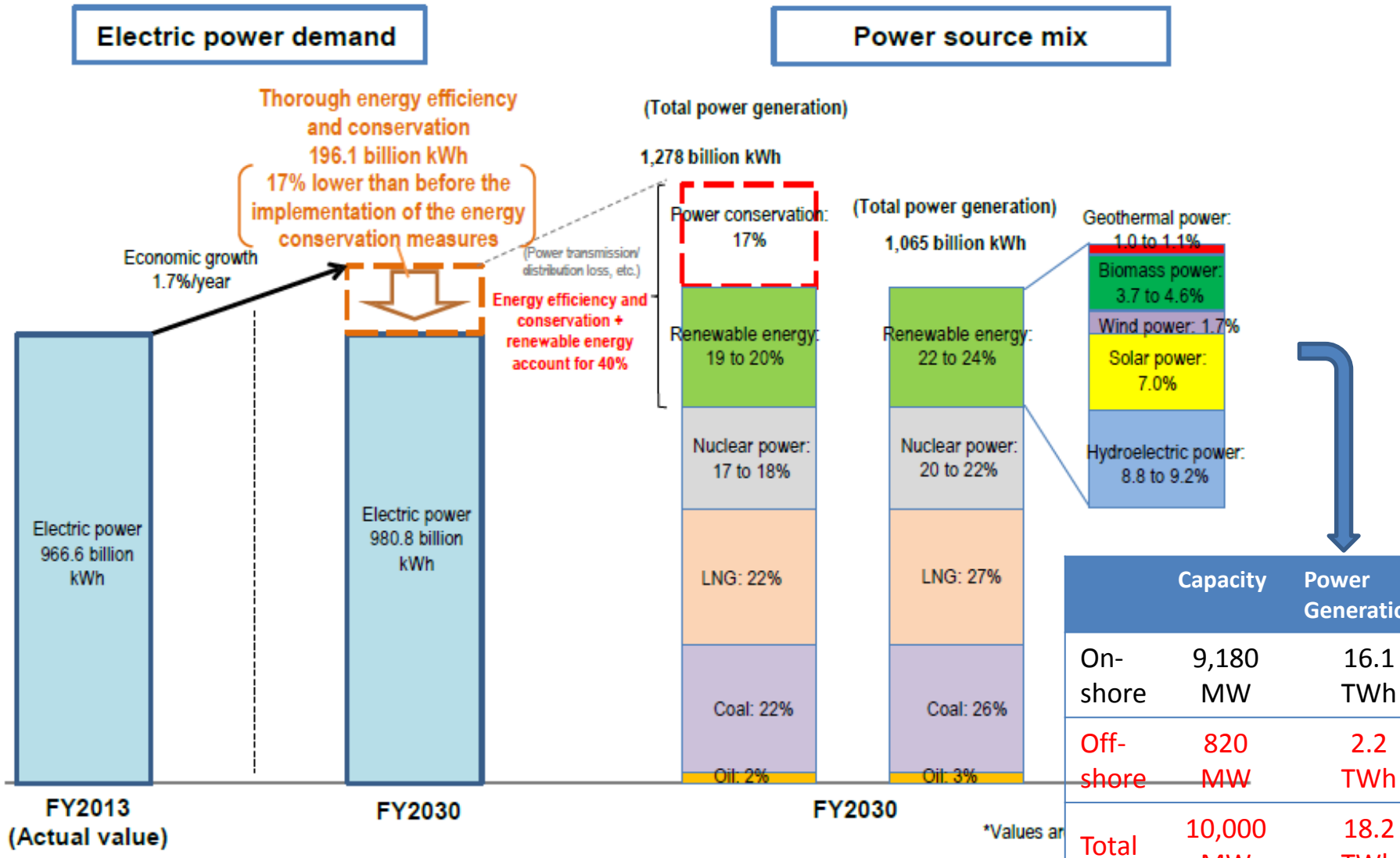
Manchester (U.K.)
Energy switching of heat consumption of households and aggregate energy storage capability

Bochum (Germany)
Medical service robots using the robot suit "HAL (Hybrid Assistive Limb)"

Malaga(Spain) (finished)
Navigate EV drivers to charging stations efficiently considering with power system and solve traffic congestions

NEDO cooperate with CDTI, to conduct Spain-Japan seminar in specific technology area.

Long-term Energy Supply-demand Outlook



	Capacity	Power Generation
On-shore	9,180 MW	16.1 TWh
Off-shore	820 MW	2.2 TWh
Total	10,000 MW	18.2 TWh

Source: "Long-term Energy Supply-demand Outlook"(METI, 2015)

Tariff for renewables in FY2016

Wind	Onshore		Offshore(*)
	Over 20kW	Under 20kW	
Tariff	22JPY/kWh 0.18€	55JPY/kWh 0.46€	**36JPY/kWh** **0.30€**
PJ term	20 years	20 years	**20 years**

*Limited to the wind firm which not only located in the offshore but also need vessels for construction and operation

PV	Under 10kW	Over 10kW
Tariff	25~27JPY/kWh 0.21€	24JPY/kWh 0.20€
PJ term	10 years	20 years

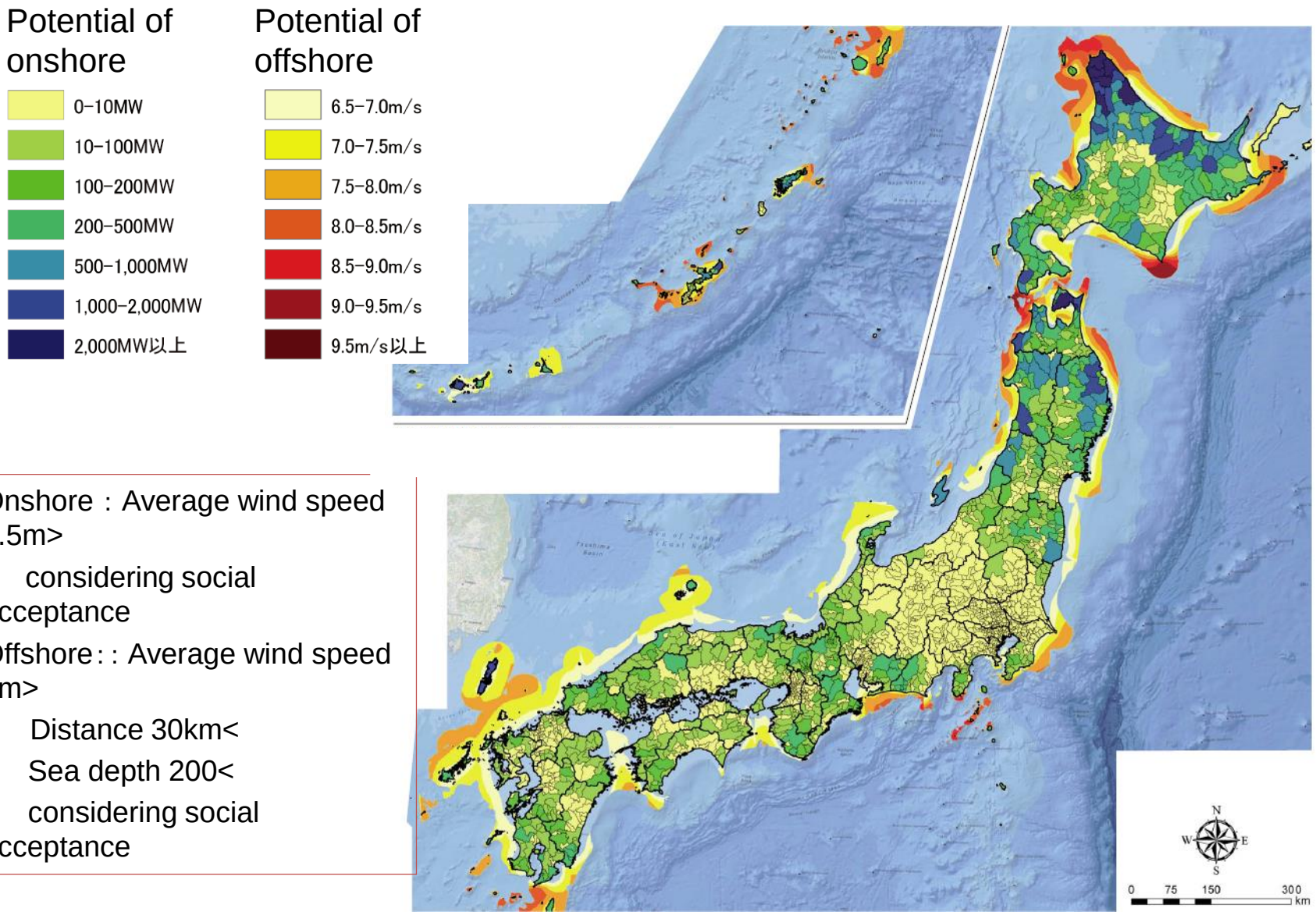
Geothermal	Over 5MW	Under 15MW
Tariff	26JPY/kWh 0.22€	40JPY/kWh 0.33€
PJ term	15 years	15 years

Biomass	Bio gas Generation	Thinned tree		Crop residue	Scrap wood	Other residue
		Under 2MW	Over 2MW			
Tariff	39JPY/kWh 0.33€	40JPY/kWh 0.33€	32JPY/kWh 0.27€	24JPY/kWh 0.20€	13JPY/kWh 0.11€	17JPY/kWh 0.14€
PJ term	20 years	20 years	20 years	20 years	20 years	20 years

*Tax will add to above tariff, JPY/EUR=120

Source: METI website(2016)

Japan has Huge Wind Energy Resources



Onshore：Average wind speed 6.5m>

considering social acceptance

Offshore：：Average wind speed 7m>

Distance 30km<

Sea depth 200<

considering social acceptance

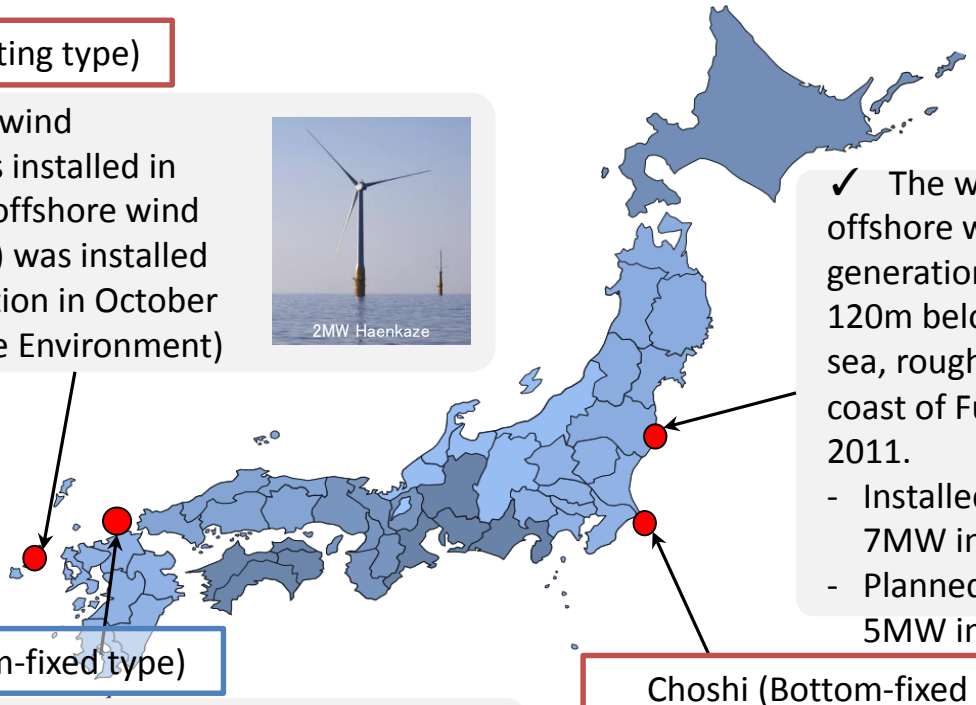
Source: JWPA

Status (1) -RD&D on offshore wind-

- There are 2 bottom-fixed offshore (Choshi and Kita-kyushu) and 2 floating offshore (Fukushima and Goto) demonstration project has been implemented.
- In addition to above PJ, new demonstration project lead by NEDO for low-cost floating offshore wind is starting.

General coastal area | Port area

(As of Jan. 2016)



Goto, Nagasaki (Floating type)

✓ Floating offshore wind turbines(100kW) was installed in June 2012. Floating offshore wind turbines (2MW-class) was installed and started of operation in October 2013. (Ministry of the Environment)

Fukushima (Floating type)

✓ The world's first full-scale offshore wind power generation is pointed about 120m below the surface of the sea, roughly 20km off the coast of Fukushima since 2011.

- Installed 2MW in 2013, and 7MW in 2015.
- Planned to be installed 5MW in summer, 2016.

Kita-Kyusyu (Bottom-fixed type)

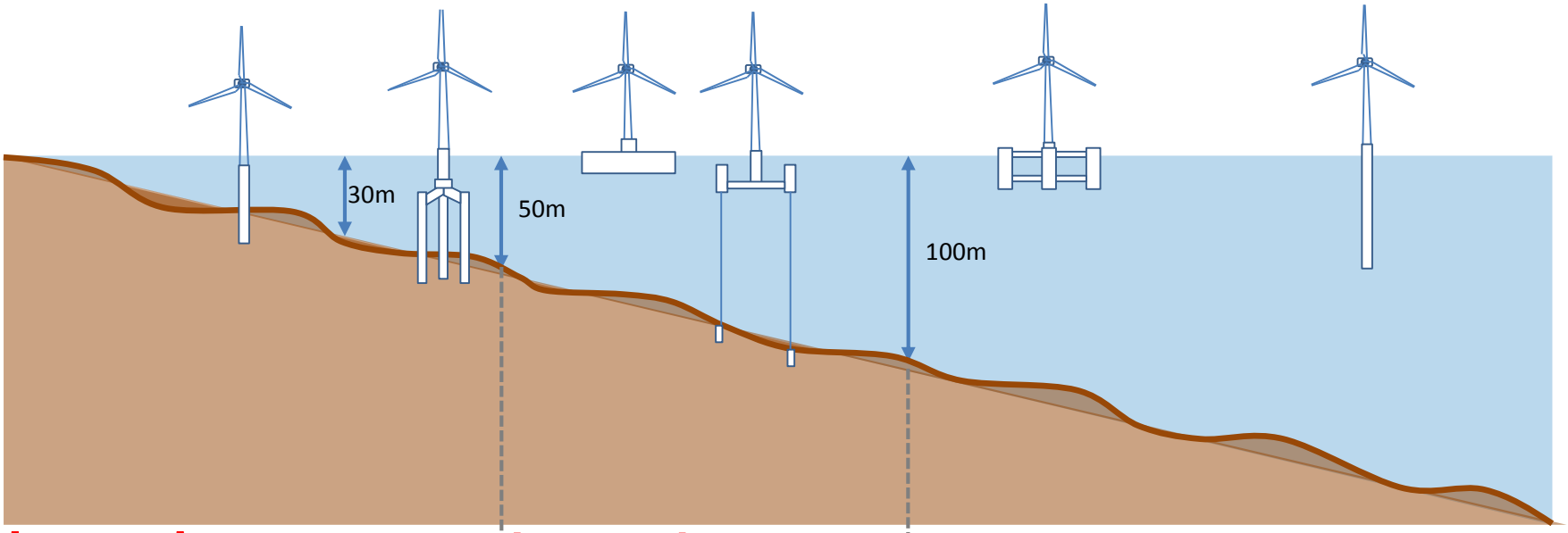
✓ Installation of 2MW-windmill was completed in March 2013. Power generation has been started since June 2013.

Choshi (Bottom-fixed type)

✓ Installation of 2.4MW-windmill was completed in October 2012. Power generation has been started since March 2013.

Source: METI

The type of offshore wind



[NEDO Project]

Gravity foundation at Choshi in Chiba Prefecture

Jacket and gravity hybrid foundation at Kitakyushu in Fukuoka Prefecture

[NEDO Project]

Demonstration of advanced floating offshore wind generation

- Water depth is form 50m to100m
- Weight reduction of floating Offshore wind turbine system

To achieve cost reduction

[METI Project]

Fukushima floating offshore wind farm demonstration project
from left, 2MW compact semi-sub, 7MW V-shape semi-sub and 5MW advanced spar

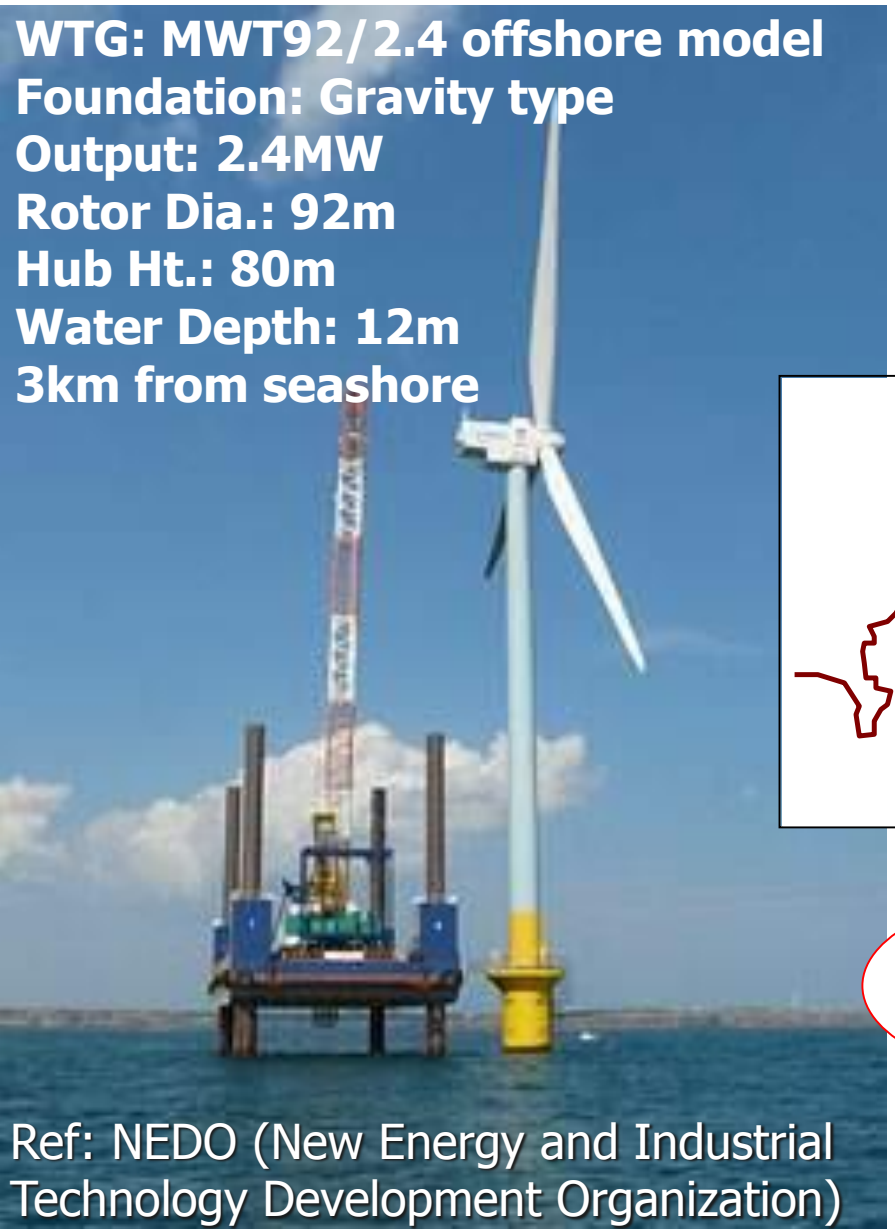
[MOE Project]

Spar type of floating offshore wind at Kabashima Island in Nagasaki Prefecture

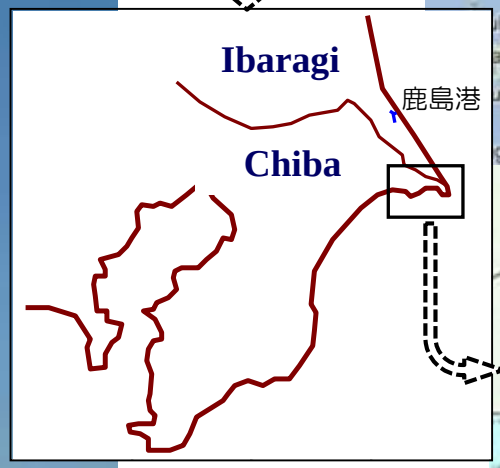
bottom-fixed ⟷ floating

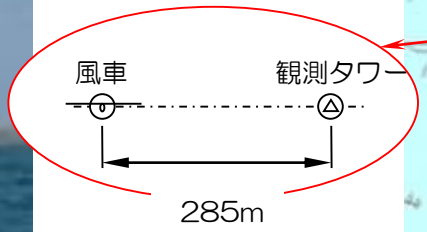
Demonstration of Offshore Wind Power Generation by NEDO, at Choshi, Chiba Pref.

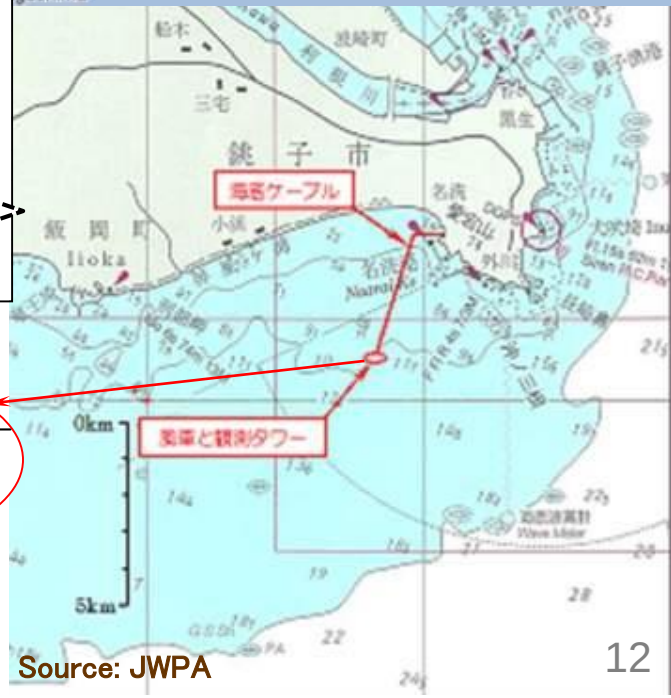
WTG: MWT92/2.4 offshore model
Foundation: Gravity type
Output: 2.4MW
Rotor Dia.: 92m
Hub Ht.: 80m
Water Depth: 12m
3km from seashore



Ref: NEDO (New Energy and Industrial Technology Development Organization)

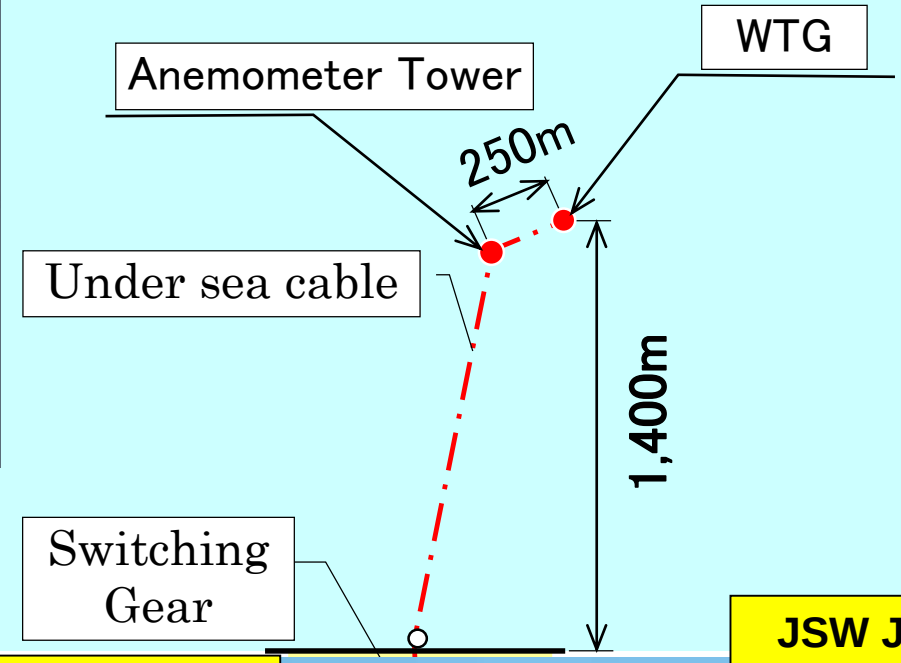


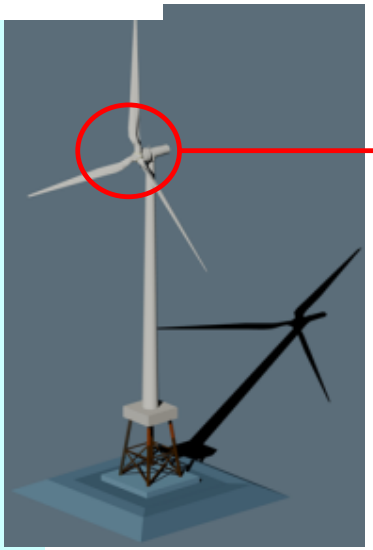




Source: JWPA

Demonstration of Offshore Wind Power Generation by NEDO, at Hibikinada, Fukuoka Pref.



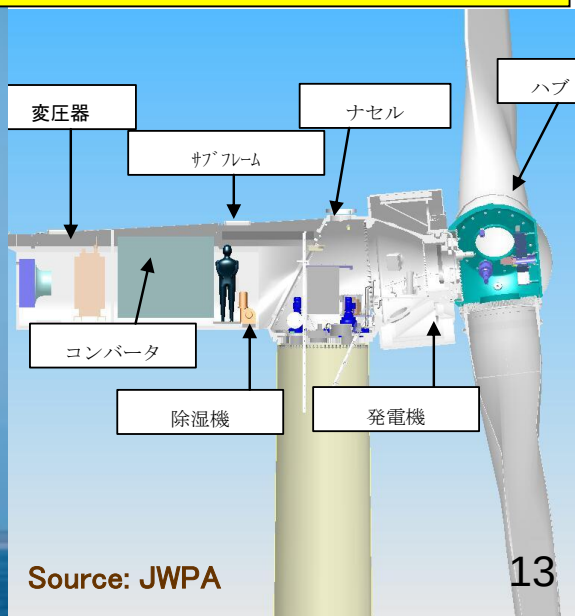


Ref: NEDO

JSW J82 2MW gearless PMSG WTG

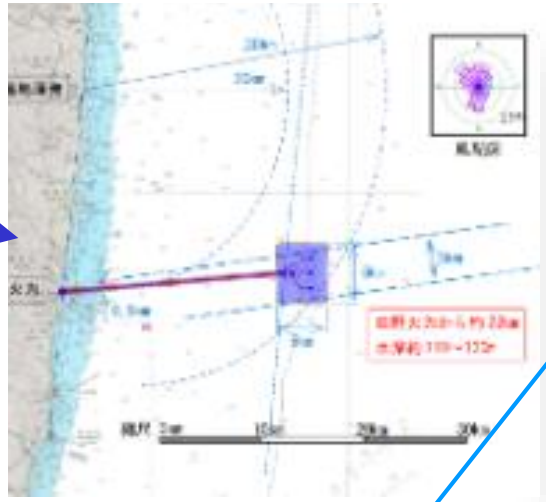
Hybrid Gravity Foundation

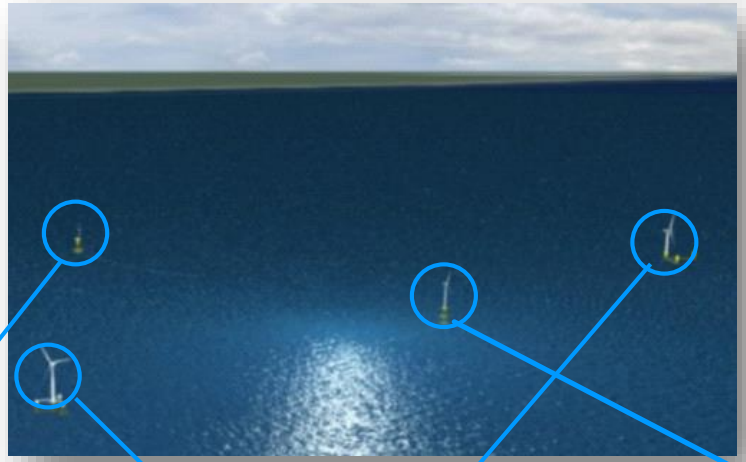
In Operation on June 2013.
Ref:NEDO



Source: JWPA

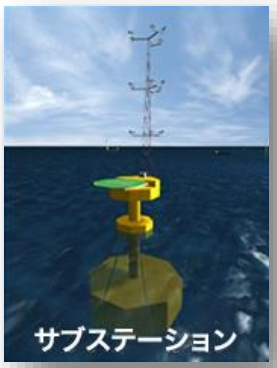
METI's Fukushima Recovery, Experimental Offshore Floating Wind Farm Project (Fukushima FORWARD)





Project Consortium:11 members

Marubeni (Project integrator)
MHI
University of Tokyo
Mitsubishi Corp.
Japan Marine United
MES
Nippon Steel & Sumitomo Metal Co.
Hitachi
Furukawa Electric
Shimizu Corp.
Mizuho Information & Research



2013

Hitachi
JMU Spar

2013

Hitachi 2MW
Mitsui semi-sub

2016

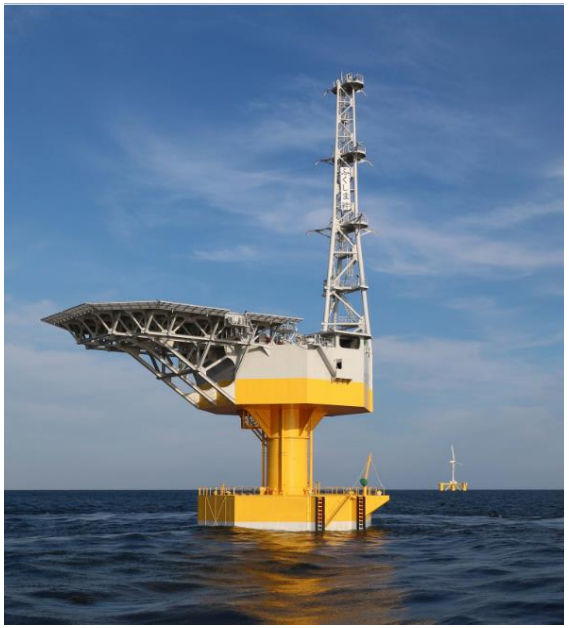
MHI 7MW
MHI semi-sub

2016

Hitachi 5MW
JMU Spar

Source; JWPA, Fukushima offshore wind consortium

Latest Picture for FukushimaFORWARD



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) ,under commissioning now

3rd floating turbine

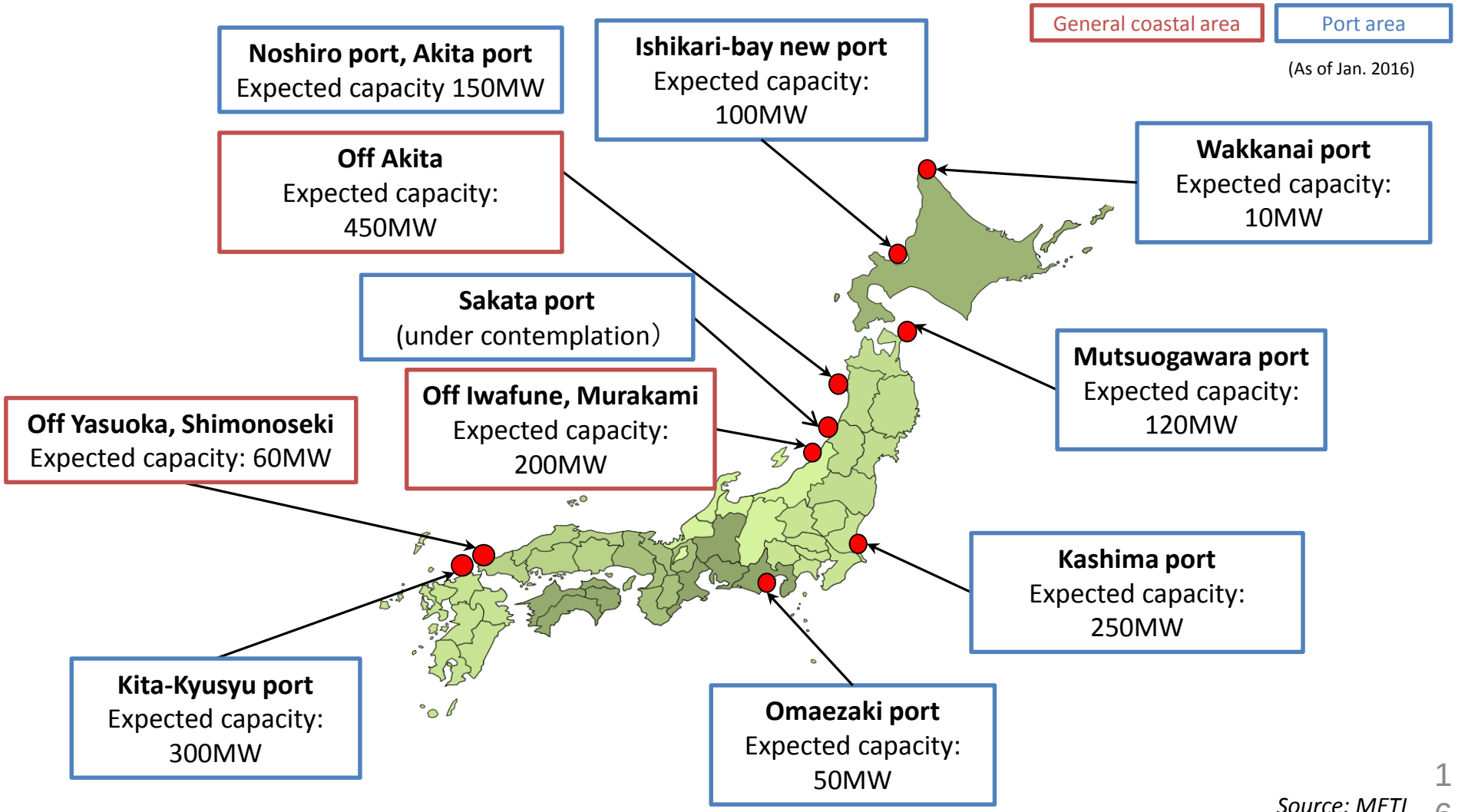
- 5MW turbine (Hitachi, downwind type) is ready for shipping.
- Advanced spar type floater is under construction at dockyard in Osaka.
- The turbine will be installed on the floater at sea and carried to Fukushima in 2016.

Fukushima Forward site (including video)
http://www.fukushima-forward.jp/english/index.html

Source: JWPA

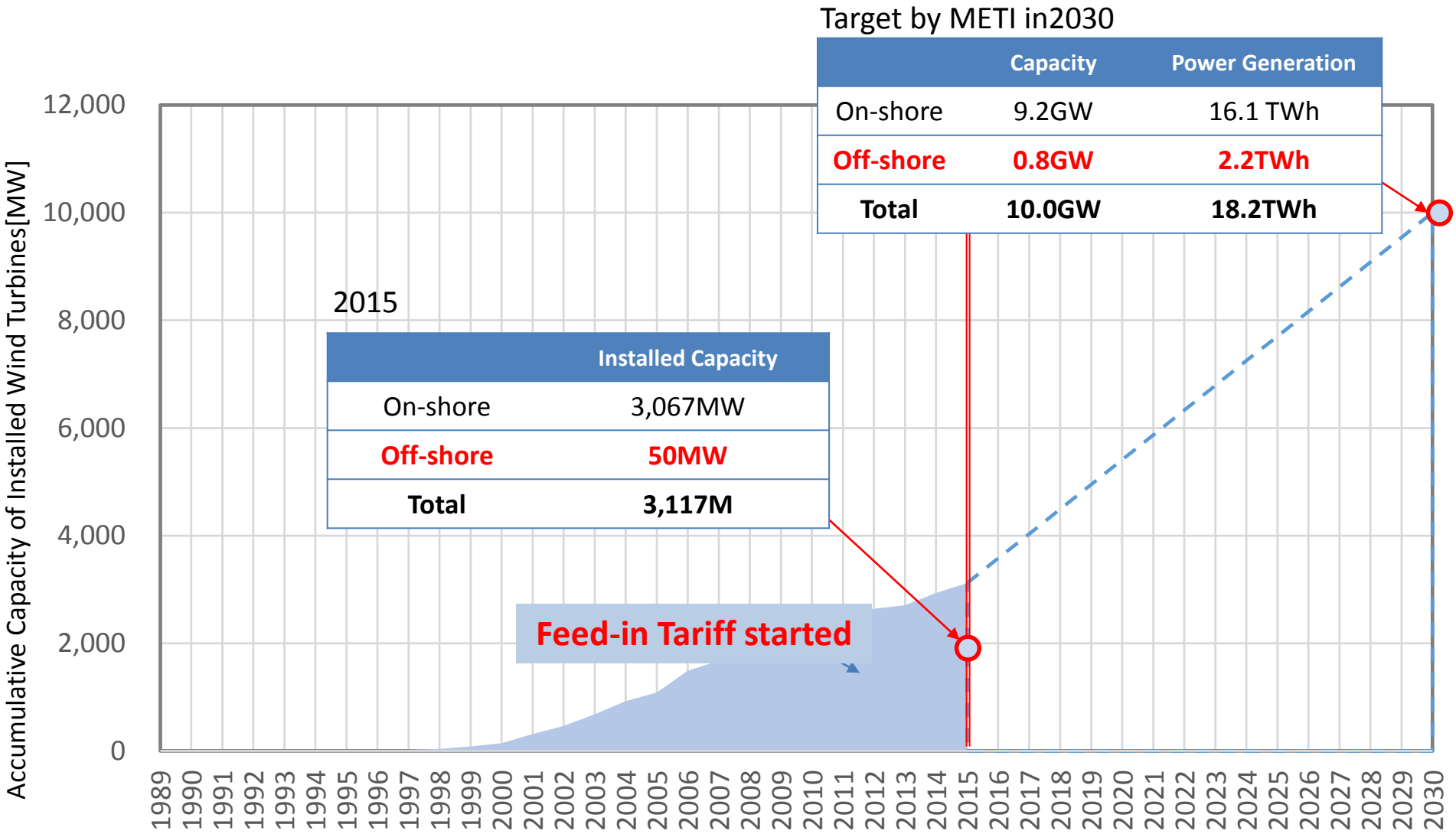
Status(2) –Commercial offshore wind projects-

- Several bottom-fixed offshore wind firm are in progress across the country.
- FIT, 36JPY(0.30 euro)/kWh, is big incentive.



Source: METI

Prospects -Accumulative Capacity Transition and Outlook in Japan-



Source: NEDO data base and "Long-term Energy Supply-demand Outlook"(METI, 2015)

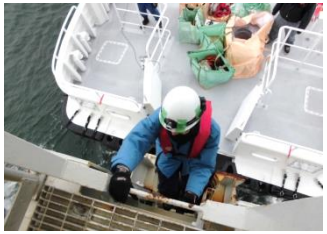
Challenges

Preliminary survey

- Adjustment the issues regarding exclusive use of the sea areas with stakeholders
- Various procedures
- Finance

Design and installation

- Limits of port infrastructures/vessels/heavy machineries for construction of the large-scaled offshore wind turbines and foundations
- Completion Guarantee, risk of delay



Operation & maintenance

- Insurances
- Wake effect
- O&M infrastructure (maintenance ships, equipment etc.)

Decommission

- How to do the decommission

Cost and Risk reduction on offshore wind
Deep Water >> Floating

What are the barriers to deploying offshore wind in Japan

There are some barriers of offshore wind in Japan. Ministry of Economy Trade and Industry(METI) has considered measures for these barriers.

・Installation area:

- Ensuring of offshore wind farm Installation area

(1) Setting guideline for installation offshore wind in coastal and port area.

(2) NEDO created offshore wind conditions map.

・Cost

- Reducing the costs (CAPEX/OPEX)

(1) Developing measures related with maintenance (R&D and human resources).

(2) Enhancing accuracy of prospect and controlling of fluctuation..

(3) Developing demonstration project(Bottom-fixed / floating)

・Infrastructure

- Developing the infrastructure such as port / construction vessel(SEP), etc

・Environment assessment

- Establishing the method of environment assessment, it will be shortened the period of assessment.

・Social Receptivity

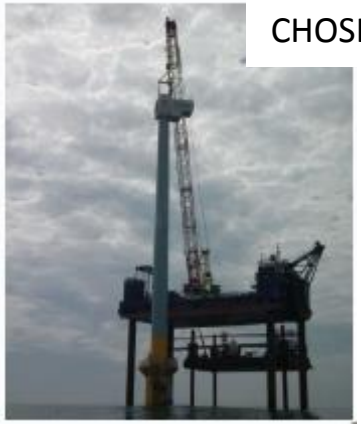
- Coordinating with fisheries and local authorities building a consensus among parties concerned

Barriers to install offshore wind(Infrastructure)

- In Europe, the ports and specialized vessels are in good condition so that it is possible to mass-produce of heavy / large structures and to convey / construction effectively.
- Japan is inferior as compared with Europe in quantity production and effective construction.

CHOSHI

KITAKYUSYU



CHOSHI

Players of the offshore wind demonstration projects

Goto, Nagasaki (Floating) by MOE	Fukushima (Floating type) by METI
 Toda Corporation Hitachi, Ltd. Kaiyo Engineering Co., Ltd. National Maritime Research Institute.	   Marubeni Corporation Mitsubishi Corporation The University of Tokyo MHI Japan Marine United MES Nippon Steel & Sumitomo Metal Corporation Furukawa Electric Shimizu Corporation Mizuho Information & Research Hitachi
Kita-Kyusyu (Bottom-fixed) by METI, NEDO	**Choshi (Bottom-fixed) by METI, NEDO**
 J-Power Itochu Techno-Solutions Corporation Port and Airport Research Institute	 TEPCO The University Tokyo

Who is the JWPA ?

- The Japan Wind Power Association（JWPA）has been founded in 2001.
- 302 companies（developers, turbine manufacturers, constructors, consultants, etc.）join JWPA at Oct.2016.
- JWPA's members own 85% of wind power installation in Japan.
- http://jwpa.jp/index_e.html

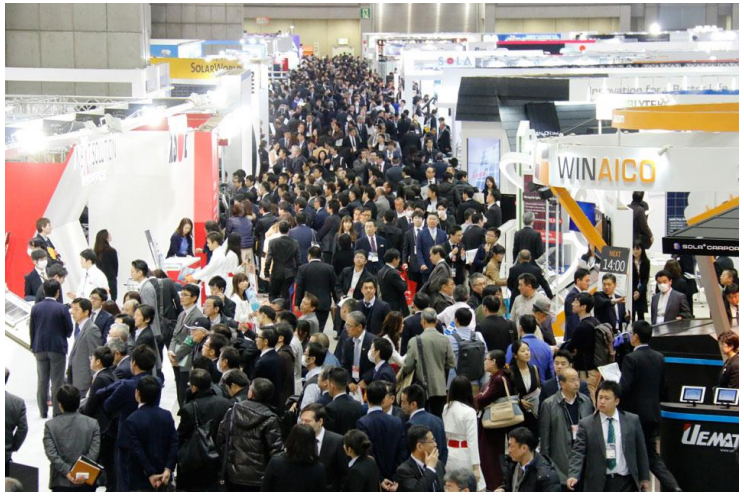
General Incorporated Association
Japan Wind Power Association

Wind expo 2017 in Japan

- Date: 01/03/2017-03/03/2017
- Venue: Tokyo Big sight exposition hall
- Exhibitor: 1,430 (Data of 2016)
- Participants: About 63,000 (Data of 2016)

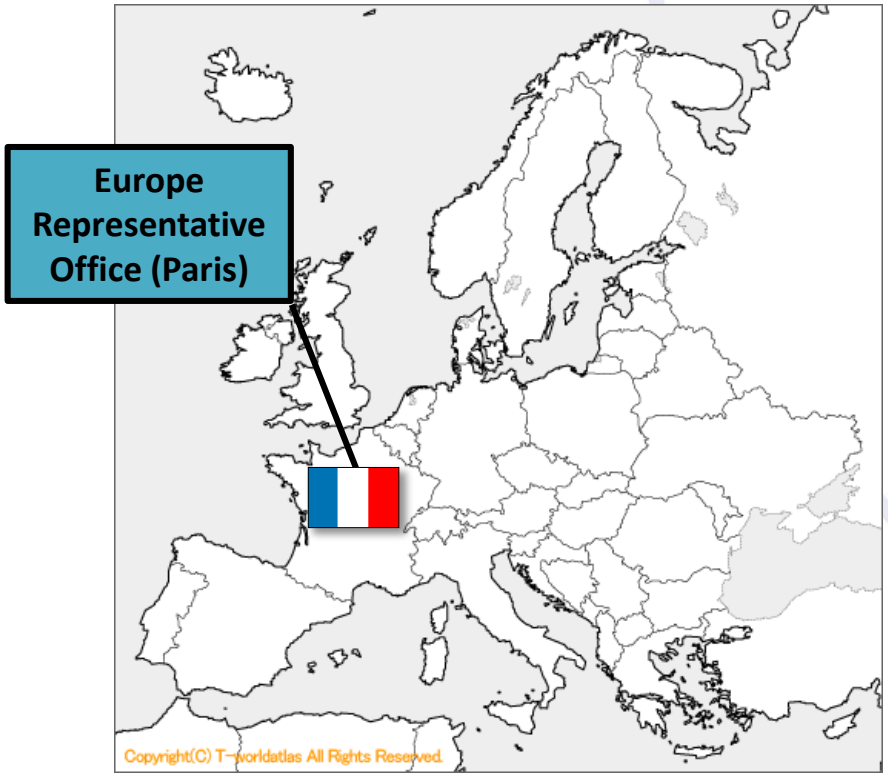
(This number is total participants of battery, PV, Hydrogen exposition in same place)

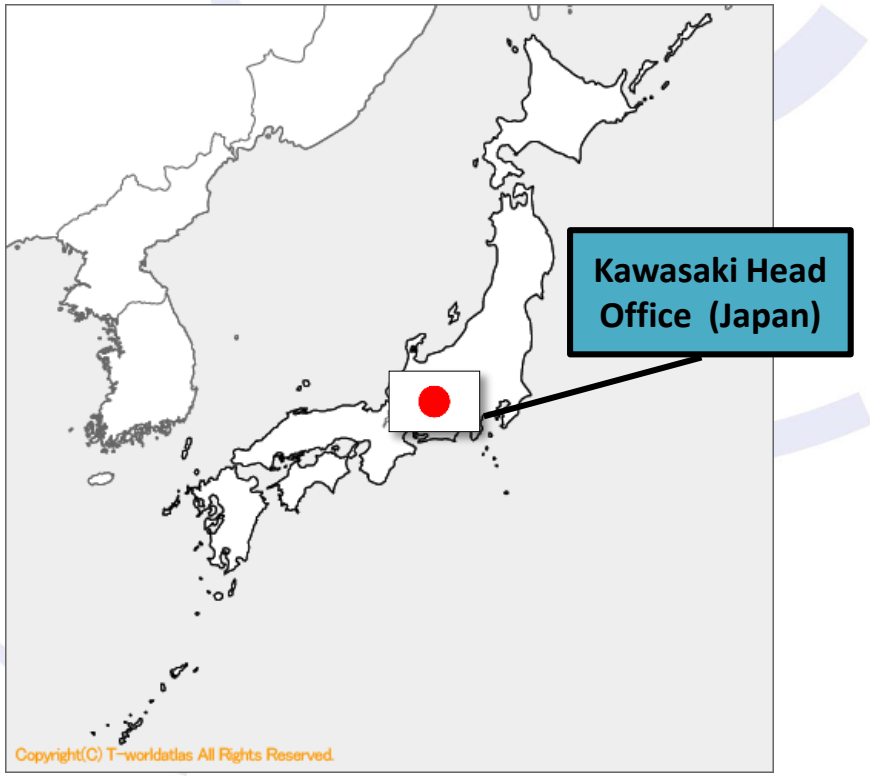
- http://www.windexpo.jp/en/



Source: Wind Expo website

Gracias!





NEDO website:

http://www.nedo.go.jp/english/index.html

NEDO Europe Representative Office:

10 rue de la paix, 75002 Paris ; tél : (+33-0) 1 44 50 18 28 ;

yamazakimth @ nedo.go.jp