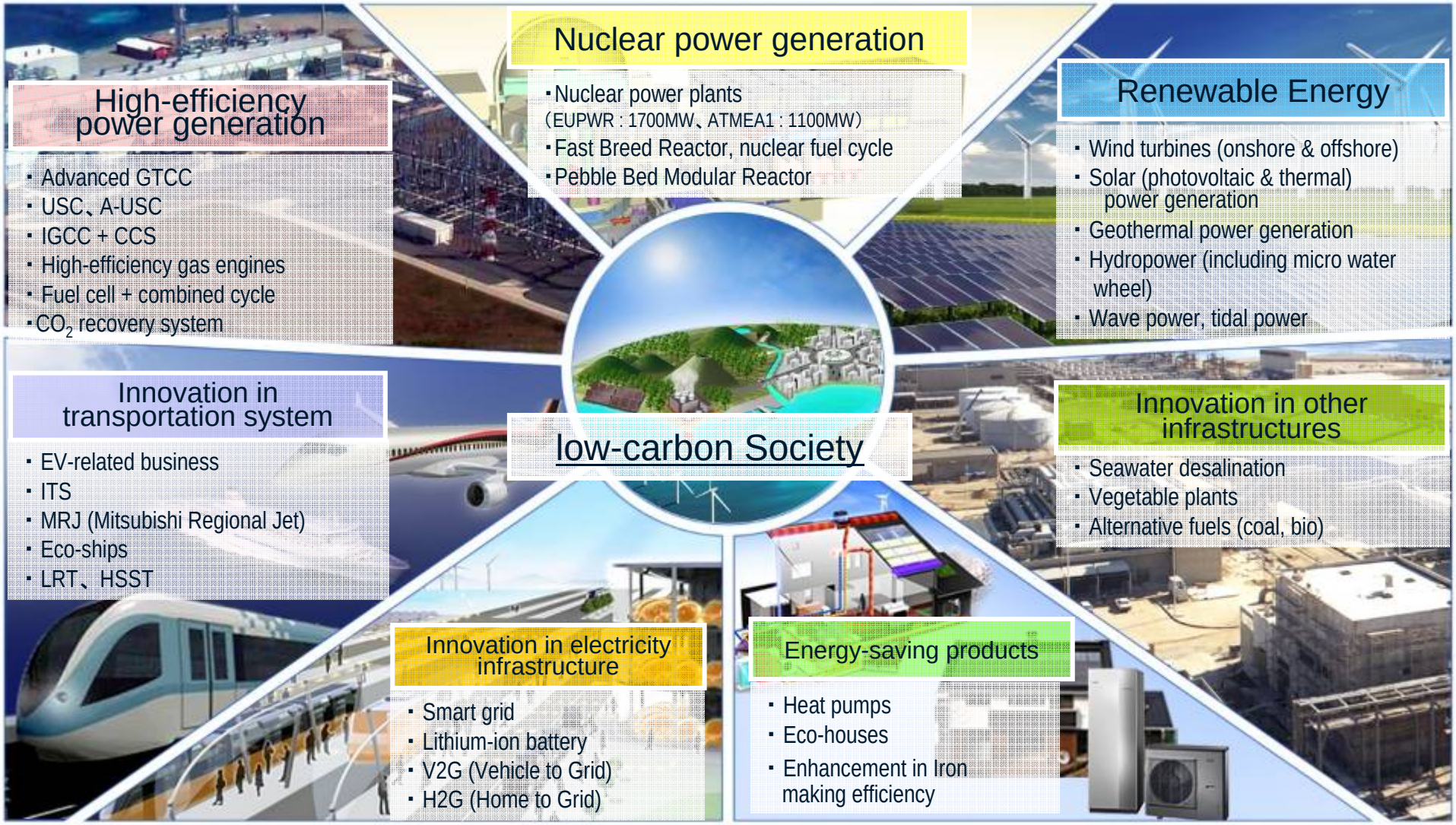
Mitsubishi Heavy Industries Wind Power Technologies

2012.5.31

Offshore Wind Turbine Project Development Department
Wind Turbine Business Division
Power Systems HQ

MITSUBISHI HEAVY INDUSTRIES, LTD.

Company Profile



MHI Products

Cruise Ship

Cable Stayed Bridge

Regional Jet

Ferris Wheel

H-Ⅱ Rocket

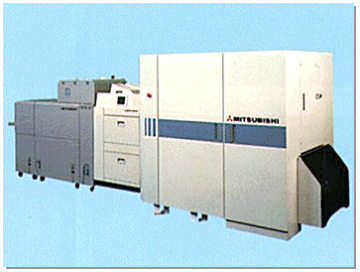
Combined Cycle Power Plant

Conventional Thermal Power Plant

Wind Turbine Plant

Flue Gas Desulfurization

Diesel Generator



Printing Machine

Air Conditioning Unit

Mitsubishi Wind Turbine : MWT-Series

MWT62/1.0

MWT92/2.4 / MWT95/2.4 / MWT100/2.4

Operation	Market launch in 2003	Market launch in 2008
Rated Output	1000 kW	2400 kW
Rotor Diameter	61.4 meters	92/95/100 meters
Hub Height	69/60 meters	70/80 meters
Power Regulation: Full Span Pitch Control		
Wind Class : IEC Class IIA,（IIB）		

Mitsubishi WIND TURBINES in The World

(As of February 2010)

Wales, UK
300kW x 103units

Winkra, Germany
450kW x 1unit

Oregon, USA
600kW x 83units
1000kW x 41units

Mojave CA, USA
250kW x 20units
275kW x 640units
500kW x 8units
600kW x 59units
1000kW x 60units

Korea
1000kW x 3 units

Buena Vista CA, USA
1000kW x 38units

India
300kW x 6 units

Iowa, USA
1000kW x 50units

Palm spring CA, USA
600kW x 111units

Japan Domestic
290units, Total 246MW

Wyoming, USA
600kW x 100units
1000kW x 50units

Texas, USA
1000kW x 764units

Portugal
500kWx20units

Bulgaria
1000kw x 35 units

Hawaii, USA
250kW x 37units

New Mexico, USA
1000kW x 80units
1000kW x 90units
1000kW x 120units

Mexico
250kW x 1unit

Peru
450kW x 1unit

4,056 units / 4,124 MW

Wind Farm in USA.

Texas

2400kW × 84 units = 201.6MW

2400kW × 118 units = 283.2MW

Total 202 units 484.8MW

California, Palm Springs 2001 600kW ×111units

Hollywood movie “Mission Impossible III” has taken here .

Colorado, Ceder Creek 2007 1000kW ×221units

Bulgaria 2008 1000kW×35units

Developed by Mitsubishi Power Systems Europe

Ehime Japan 2003 1000kW ×11units

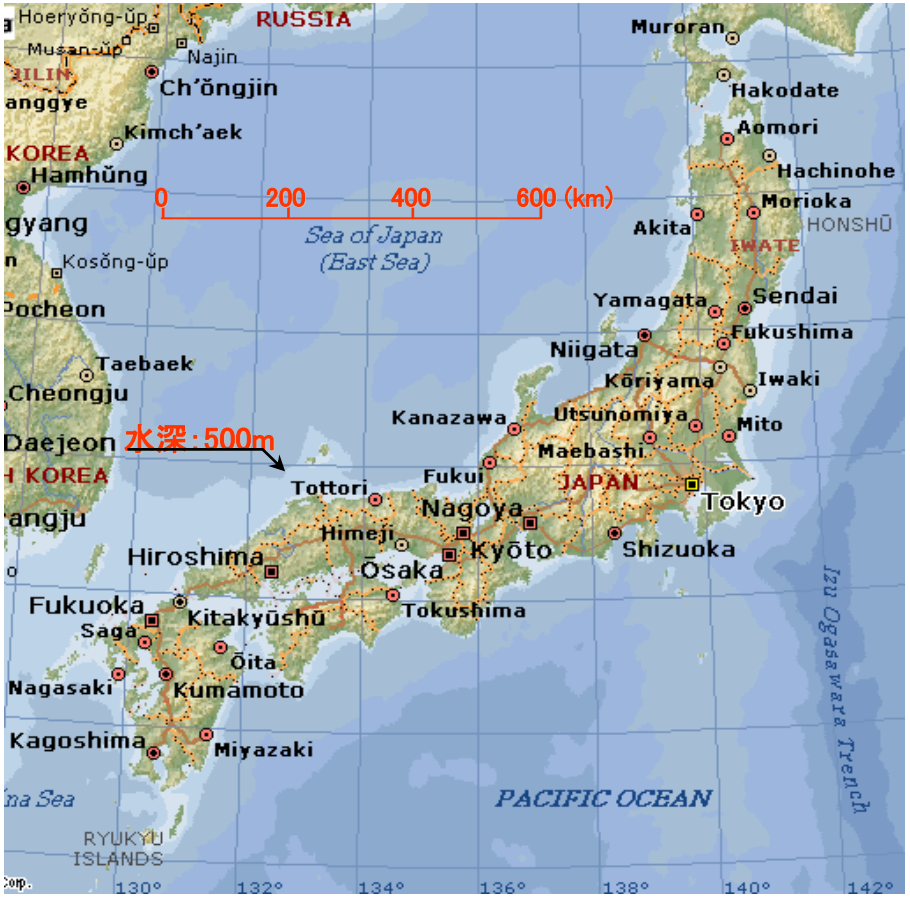
Developed by Mitsubishi Heavy Industries

Offshore wind turbine

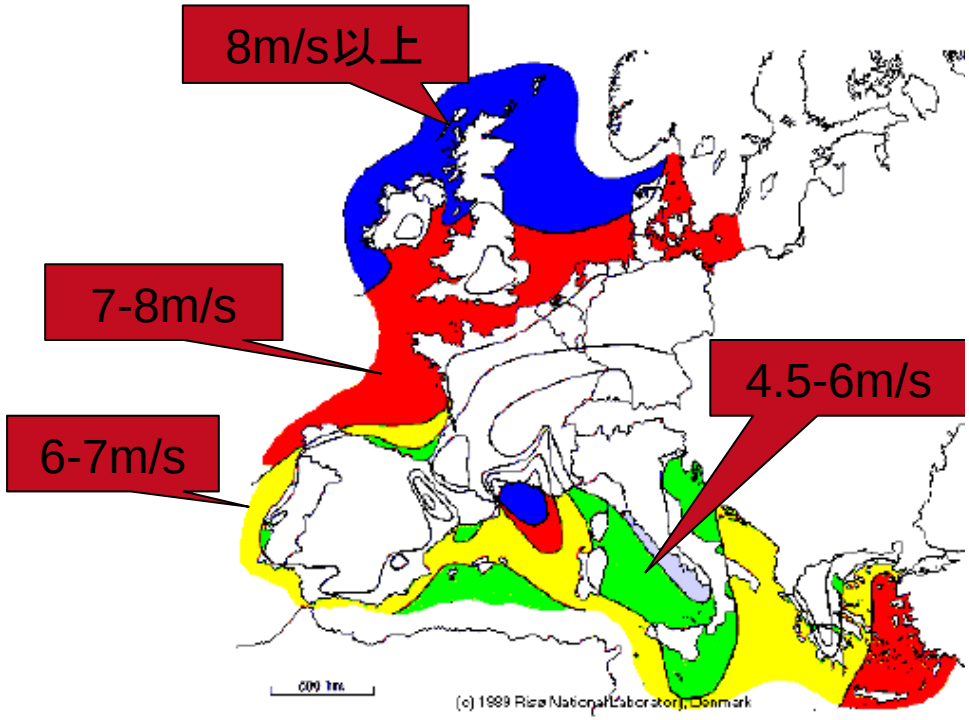
MHI has been developing offshore wind turbine through support by NEDO（New Energy and Industrial Technology Development Organization）and BIS（UK department of Business, Innovation and Skills）

Japan sea vs North sea

- Japan is surrounded by deepest sea in the world.
- Most of EEZ (Exclusive Economic Zone) are very deep（＞1,000m depth）
- Very few sea area are suitable for Offshore wind turbine.



■Av. wind speed ＞8m/s



■Av. sea depth 50～70m

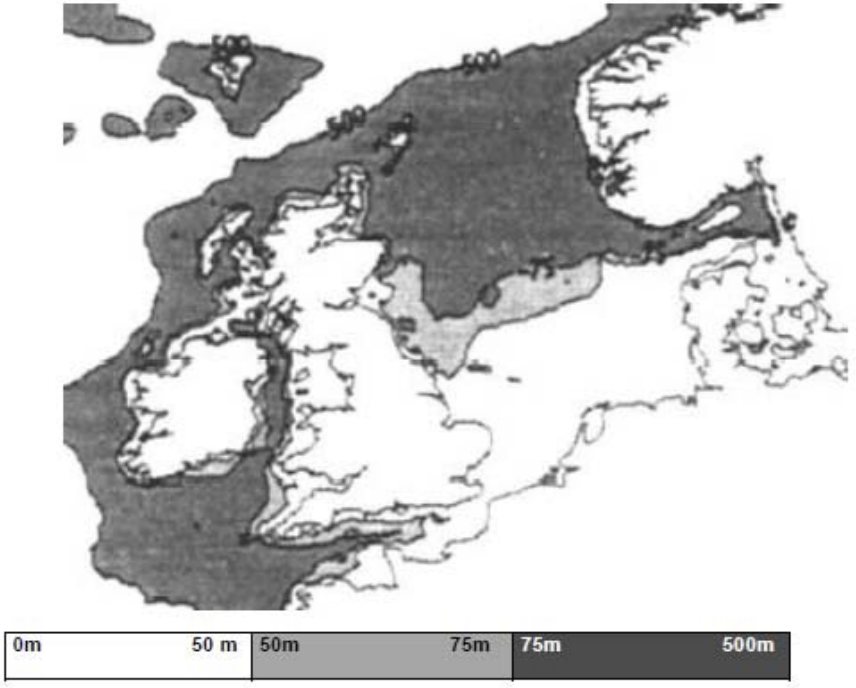
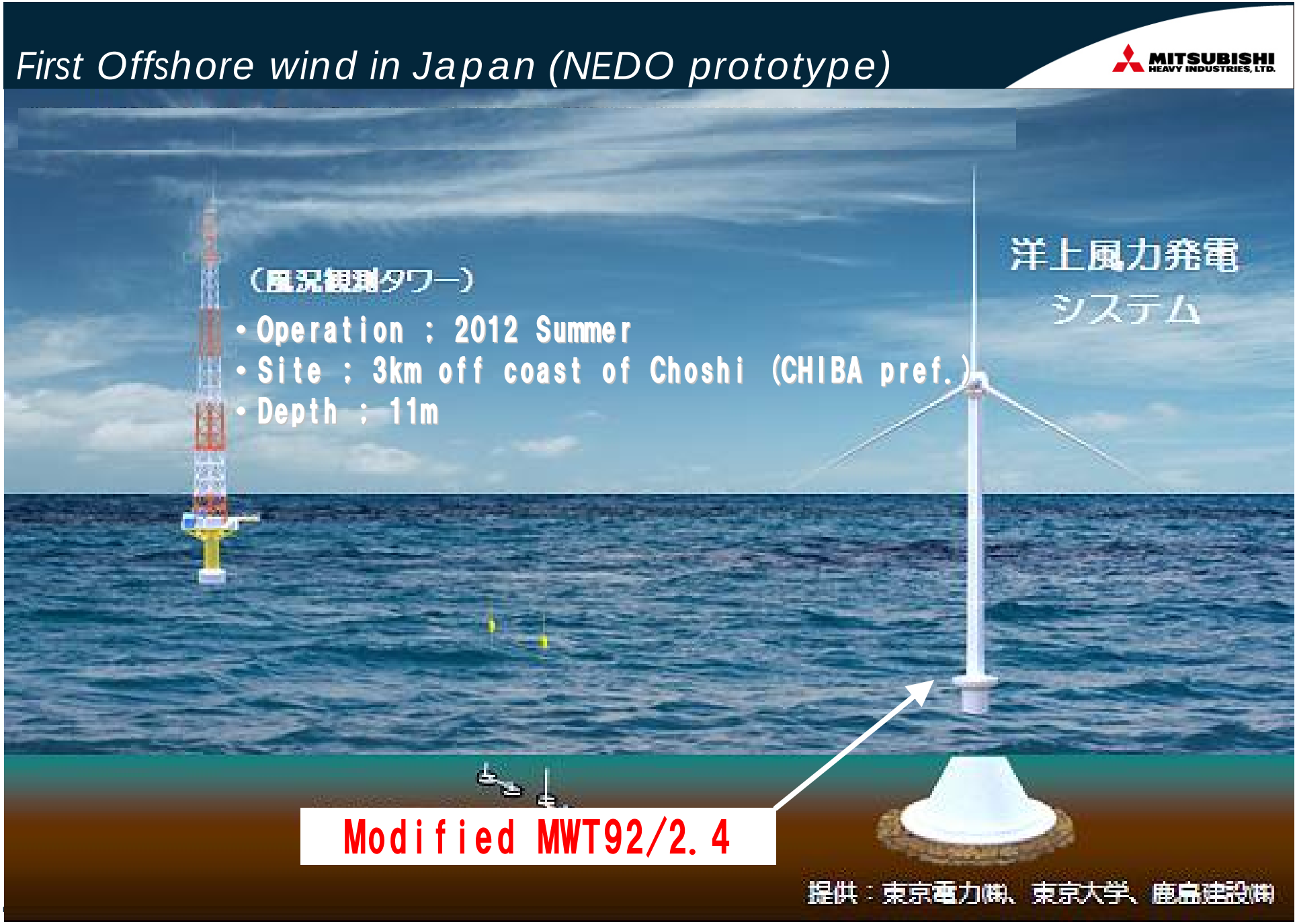


Fig. 2.7: North Sea water depths (source: National Geophysical Data Centre NOAA).

First Offshore wind in Japan (NEDO prototype)



Mitsubishi Offshore Windturbine

SEA ANGEL OFFSHORE WIND

Type: Hydraulic transmission variable speed
Rated capacity: 7MW
Wind class: IEC61400 class-1 offshore
Generator type: Synchronous brushless
Rated speed: 1,000 rpm
Demonstration start from Jun2013

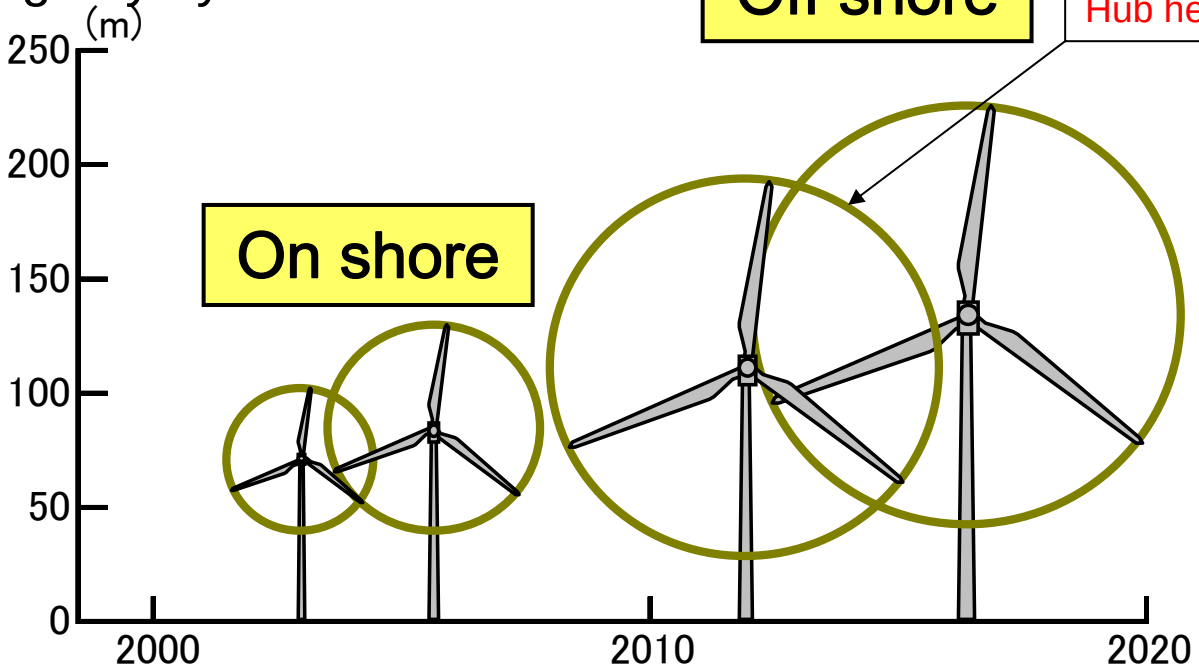
Turbine Size

Off shore wind turbine is getting more larger output because of stronger wind speed and site availability.

Key technology for scale up from 2MW to 7MW

- Longest blade with carbon composite
- Modular design by hydraulic drive train

7.0MW
rotor： more than165m
blade： more than 80m
Nacelle weight：approx 550ton
Hub height：110～120m



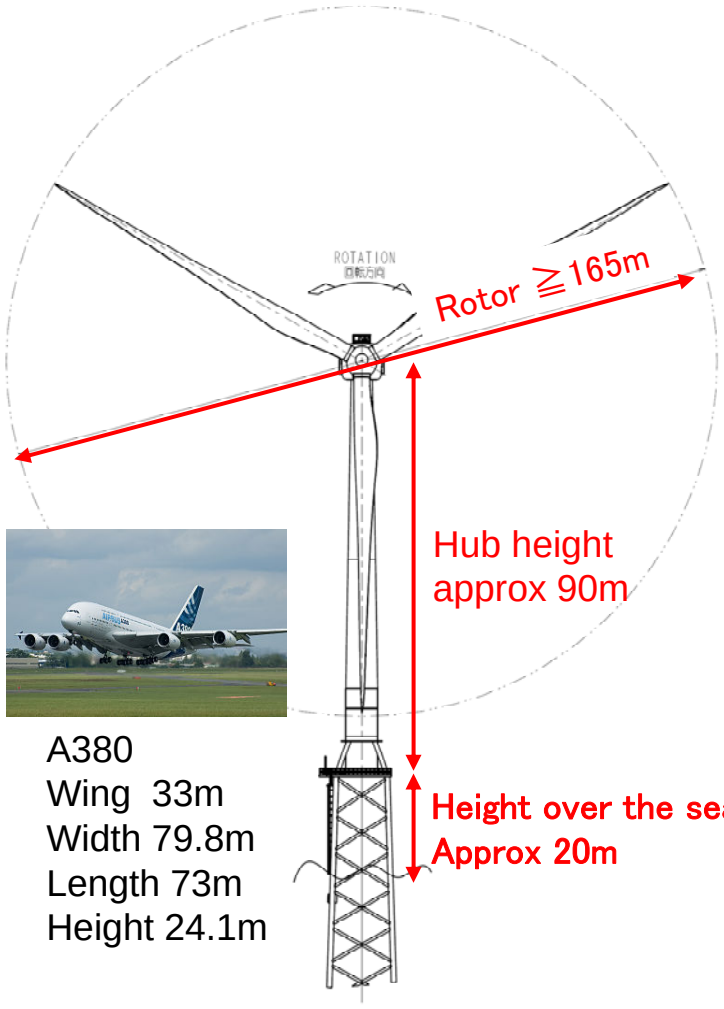
output	1MW	2～3MW級	5～7MW級	10MW超級
diameter	62m	100m級	160m級	180m級

Concept of 7MW ①

Our target is the Highest CF, Less cost, High availability with following concepts.

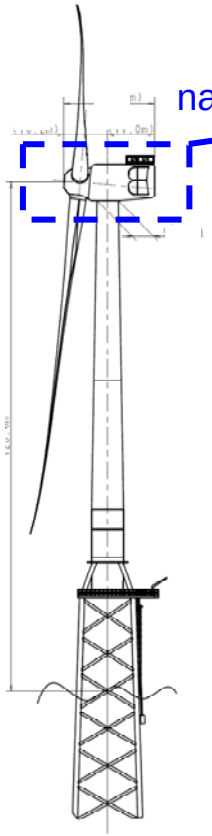
- **Longest blade (Rotor Diameter:165m more), Highest CF (CF: over 55%), Large output (7MW)**
  Our target CF is more than 55% which is the highest CF at this moment
- **High generated power quality, Grid conformity**
  Adoption of brushless synchronous generator (constant speed control), similar to thermal power plant
- **High reliability and robustness by adoption of hydraulic drive**
  Exclusion of gearbox and converter which minimizes serious failure for existing wind turbine
  High availability and robustness of operation sustainability even under the partial cylinder failure
  Partial replacement rather than the whole replacement in comparison with a geared type
- **Low maintenance cost**
  High maintainability for parts replacement just performed inside nacelle (lifting inside tower)
- **Less cost**
  Commercially Viable and bankable with hydraulic equipment, material and synchronous generator (Low procurement risk by exclusion of rare earth)
- **Modular design**
  Enlargement is relatively easier and more flexible (short development term, low development cost) by modular design of hydraulic drive

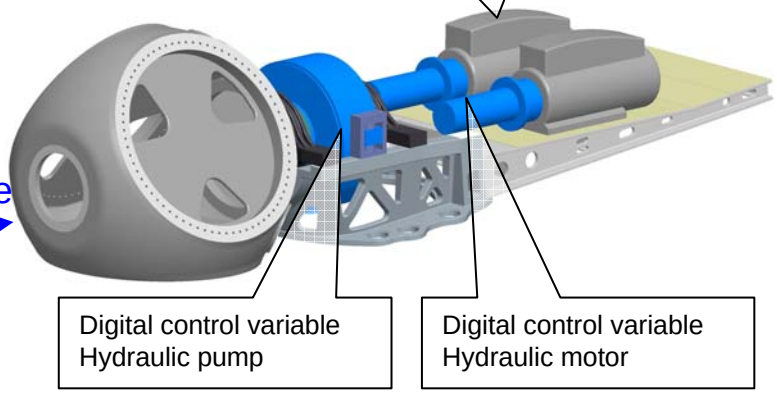
Concept of 7MW ②



A380
Wing 33m
Width 79.8m
Length 73m
Height 24.1m

Hydraulic transmission





Artemis intelligent Power (UK venture acquisited 2010)

ARTEMIS
INTELLIGENT POWER LTD

CARBON TRUST
Innovator of the Year

Edinburgh, Scotland
30 employees; 5 Phds
Sparked by research on wave power at University of Edinburgh
Licensing business model
Supporting licensees from concept to product

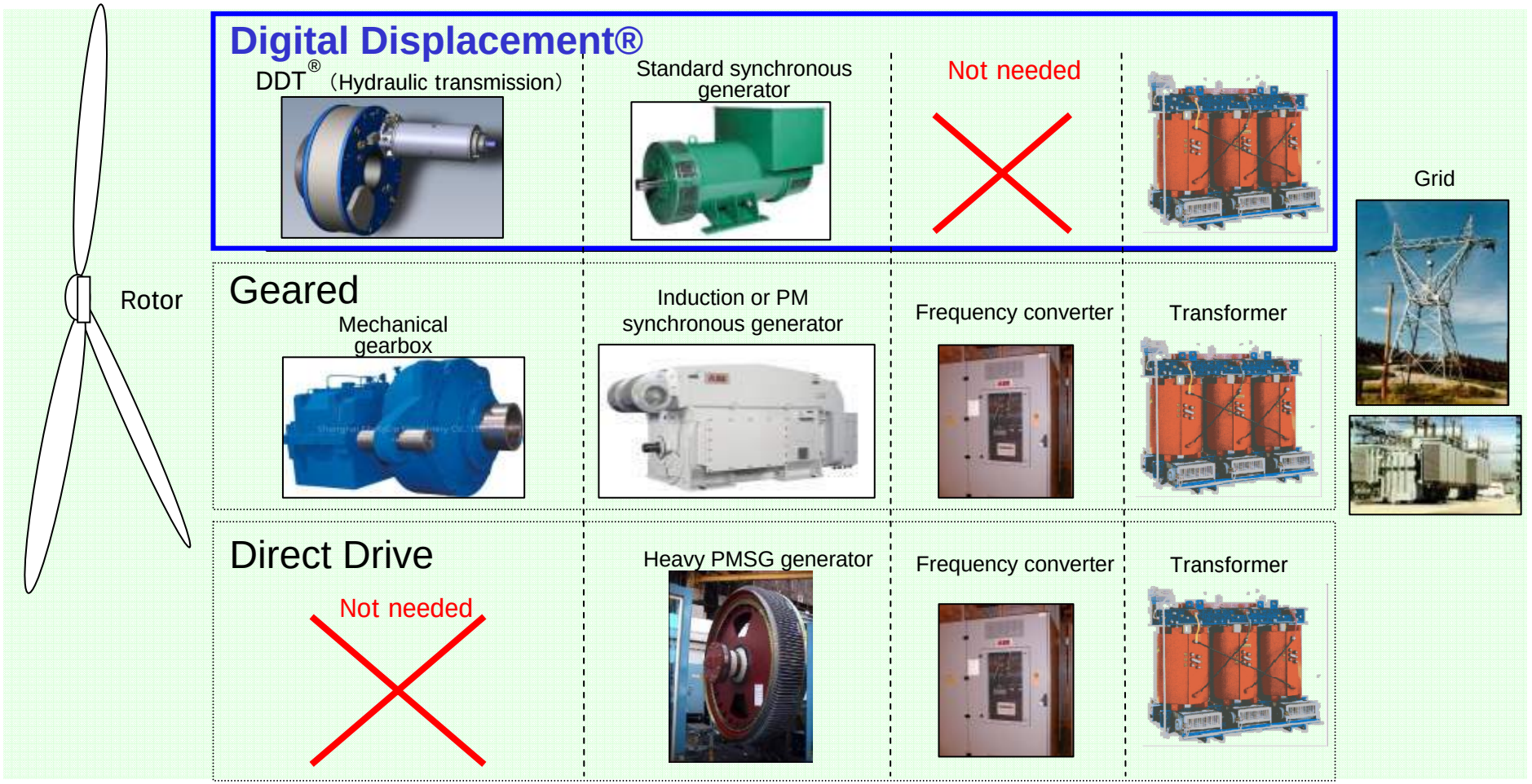
Patents

Granted: >20 patents (>8 families)

Applications: >30 new families

Advantage of DDT hydraulic drive train

- not needed gear box
- adoptable standard synchronous generator
- not needed frequency converter



Infrastructure

Easy to access to site

Quay berth for ocean-going ship

Business cluster for Wind business

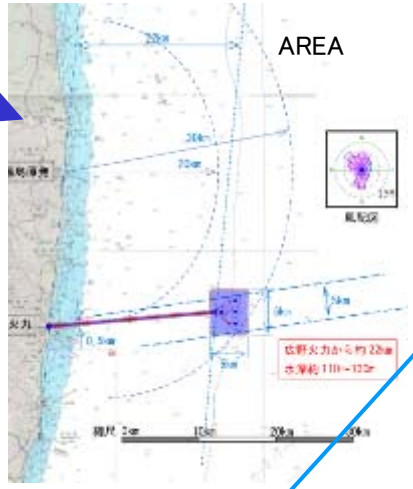
Floating type offshore wind turbine

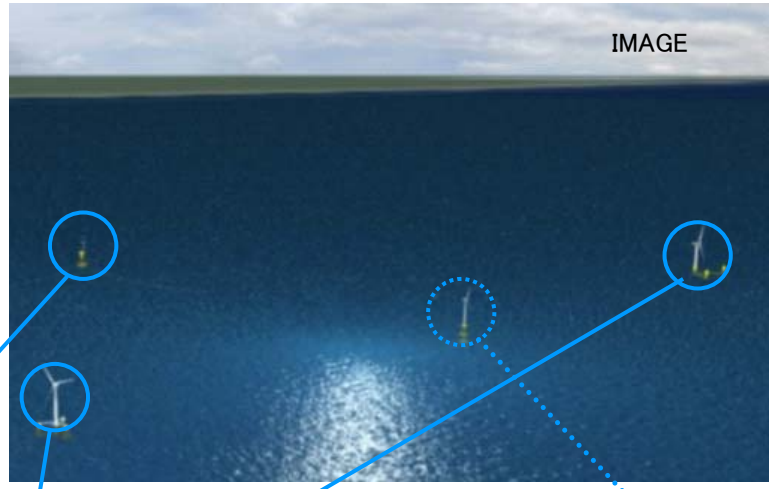
MHI is developing floating type offshore wind turbine through support by METI（Ministry of Economy, trade and Industry）

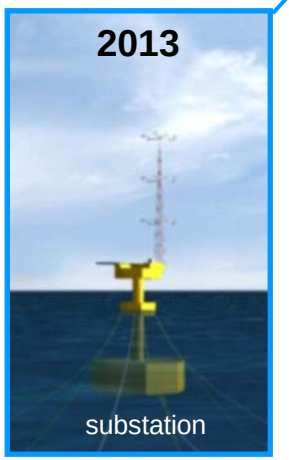
Mitsubishi Floating type Offshore Windturbine

Location: Fukushima offshore
Type: Hydraulic transmission variable speed
Rated capacity: 7MW
Demonstration start from 2014

Fukushima floating type Offshore Windturbine Project







Wind turbine Float	Hitachi IHI-MU	Fuji2MW Mitsui	MHI 7MW MHI	（not fixed） IHI-MU

Thank you for your attention.