5th November 2015

CIGS Seminar
On Offshore Wind and Ocean Renewables

Overview of Japan

with Global Market

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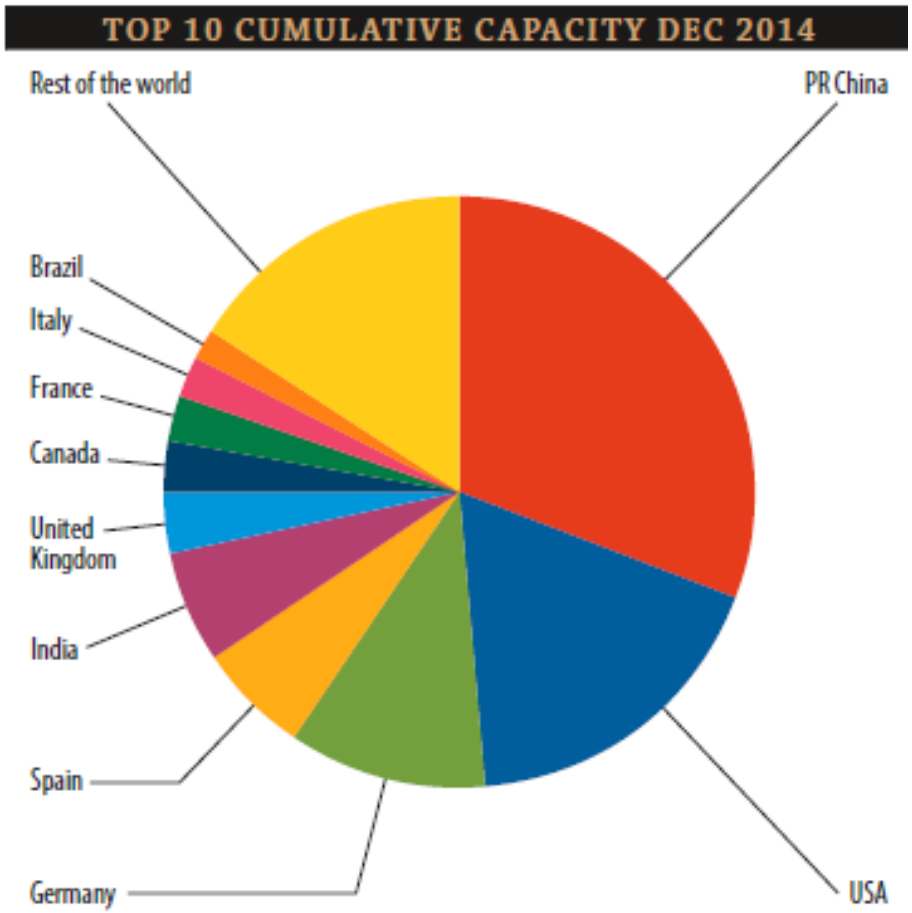
Mitsui Global Strategic Studies Institute

Contents

Global Wind Market

WTG Capacity by Country

(Global Cumulative Capacity: 370GW at end 2014)



Ranking (Share)

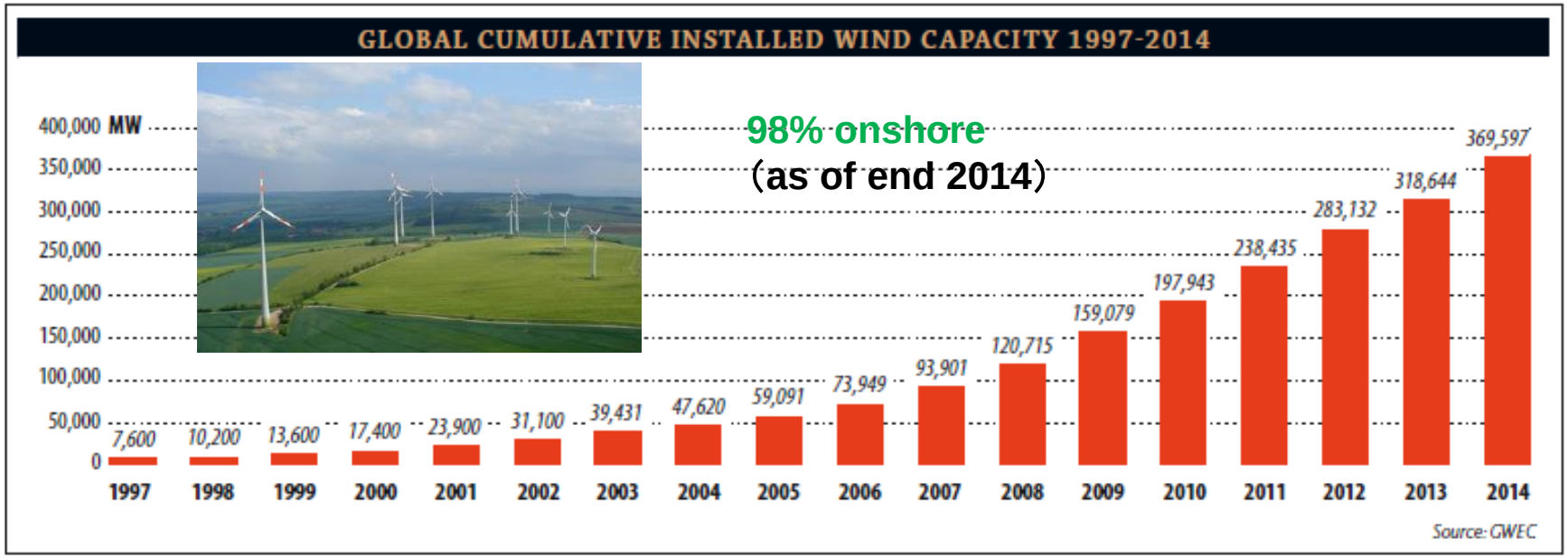
China	31.0%
USA	17.8%
Germany	10.6%
Spain	6.2%
India	6.1%
UK	3.4%
Canada	2.6%
France	2.5%
Italy	2.3%
Brazil	1.6%

Top10 total 84.1%
(311GW)

Global total 370GW

(Source: GWEC)

Global Wind Market until now
(Cumulative capacity : MW)



Wind is one of most growing industry

2004 : 47.6GW→2014 370GW

Expanding 7.8times in 10years until 2014

From 1997: 13times in 10years

50times in 17years until 2014

Global Wind in 1997 was 7.6GW

(Offshore wind in 2014 was 8GW)

Annual Generation Capacity in 2010: 430TWh
equivalent to 2.5% of Global Electricity Demand
Job in Global Wind industry : 670million in 2010

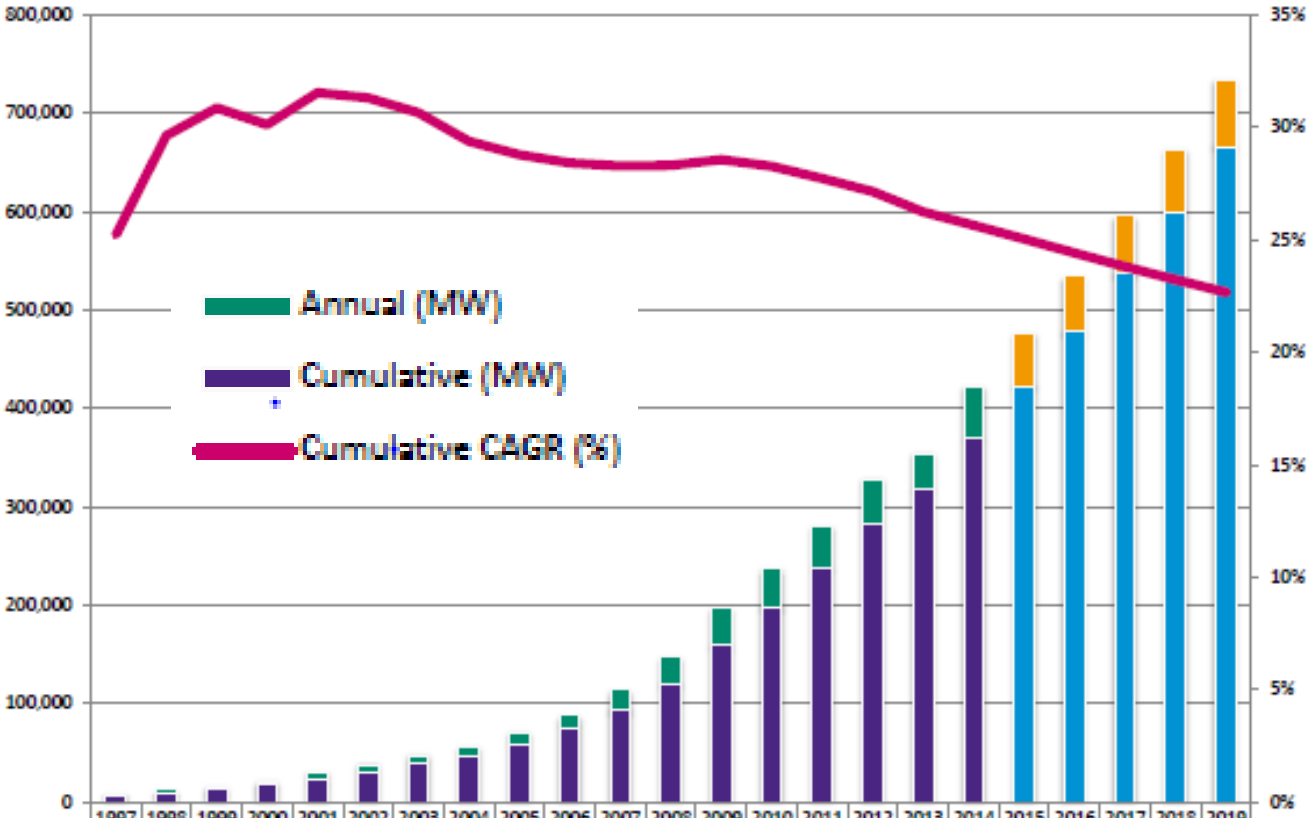
Global Wind Market ongoing

(2014-2019)　(Cumulative Capacity : GW)

Global Capacity will be expended by 1.8 times in 5 years to 666GW in 2019 from 370GW in 2014

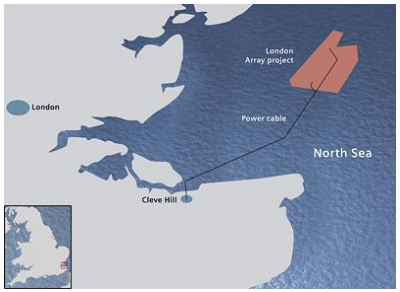
8GW 1997→ 370GW 2014 → 666GW 2019

(Source: GWEC(Global Wind Energy Council))



	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Annual (MW)	1,530	2,520	3,440	3,760	6,500	7,270	8,133	8,207	11,53	14,70	20,28	26,95	38,47	38,98	40,94	44,92	35,69	51,47	53,50	55,50	58,50	62,50	66,50
Cumulative (MW)	7,600	10,20	13,60	17,40	23,90	31,10	39,43	47,62	59,09	73,94	93,90	120,7	159,0	197,9	238,4	283,1	318,6	369,5	423,1	478,6	537,1	599,6	666,1
Cumulative CAGR (%)	25.2%	29.6%	30.9%	30.1%	31.5%	31.3%	30.6%	29.4%	28.8%	28.4%	28.3%	28.3%	28.6%	28.3%	27.7%	27.1%	26.2%	25.6%	25.0%	24.4%	23.8%	23.2%	22.7%

Global Offshore Wind Market



London Array

UK Round2 630MW
175 SWT-3.6 turbines
and two offshore SS
20km offshore Kent coast
Commission April 2013
Construction Cost ￡1.8Bil
(3,300億円)

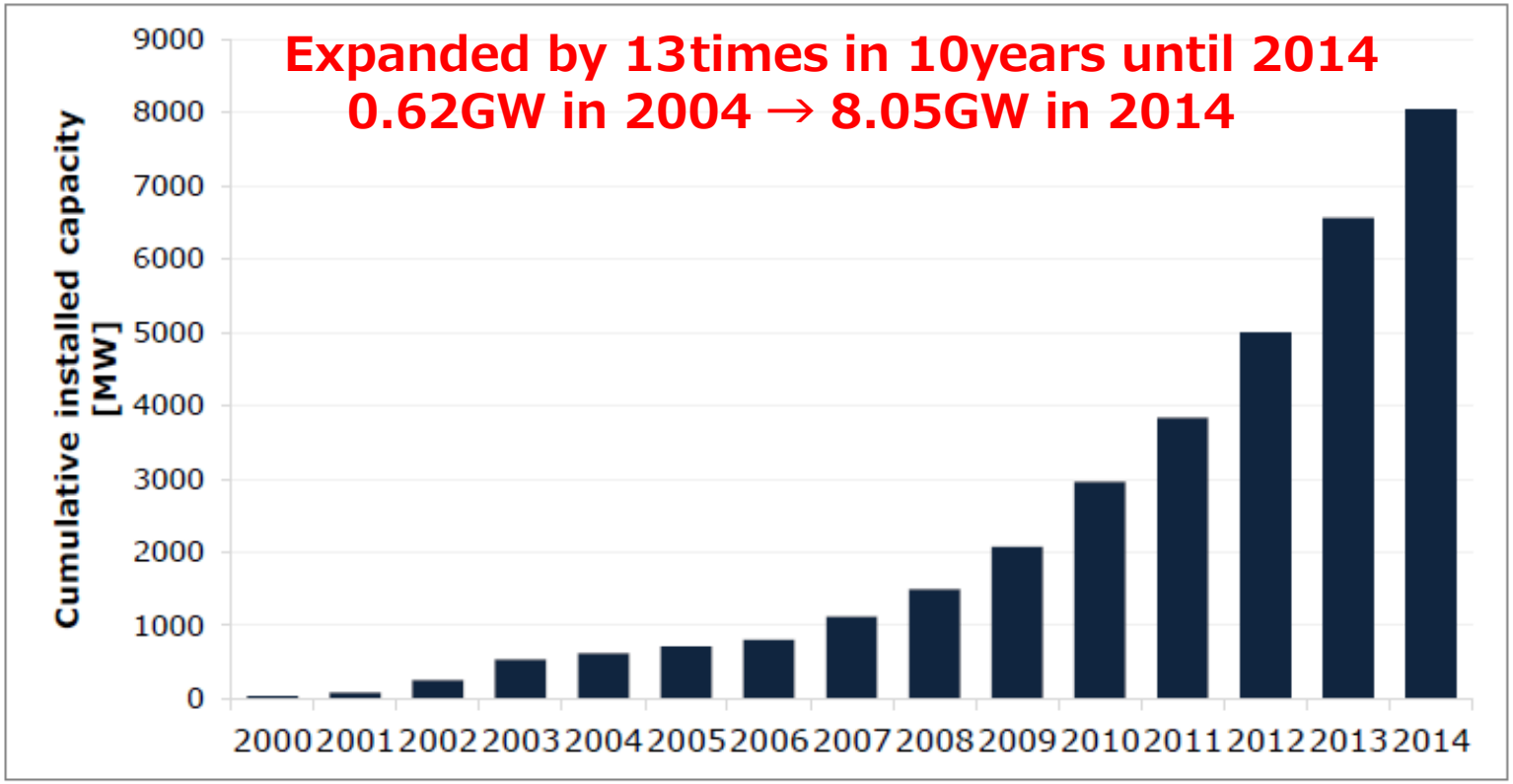
London Array (1:46)
https://www.youtube.com/watch?v=s7ITjrlqFco&feature=player_embedded

Offshore Wind Market in Europe until 2014
(Cumulative Capacity : MW)

Europe leads offshore wind market

2010 : 3GW → 2014 : 8GW → 2020 : 24GW

(equivalent to 24 big Nuclear Reactors)



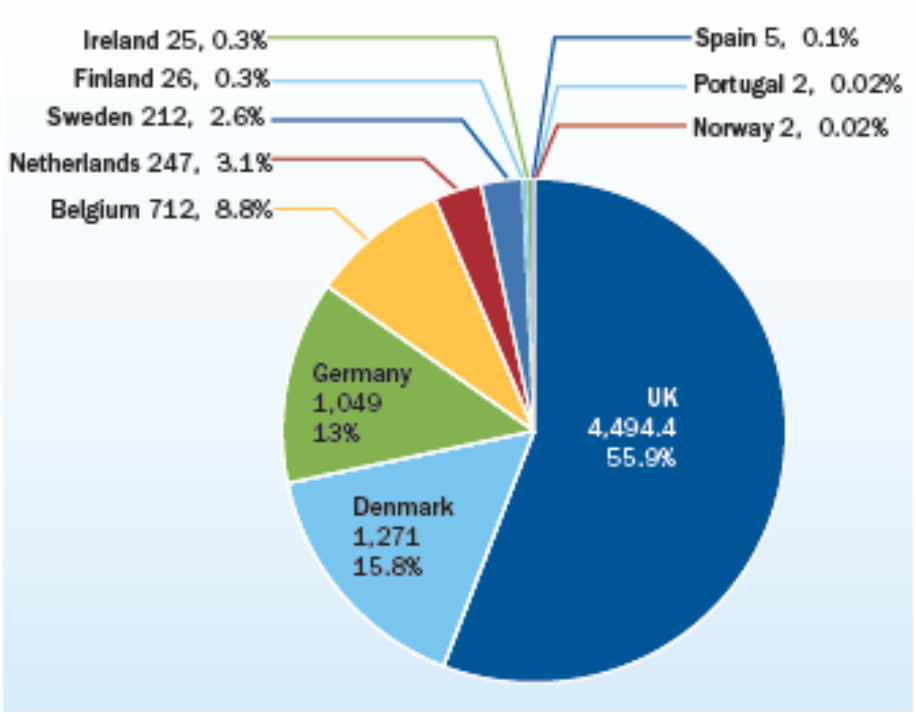
Cumulative Capacity of Offshore Wind in Europe

(Source : DNV GL based on EWEA)

Offshore wind in European Countries

(end of 2014 : MW)

UK as No.1. Following by Denmark, Germany, Belgium, Netherland, Sweden.
UK will start construction of UK offshore wind Round 3 (31GW) soon.
France will enter into offshore wind market.



（Source：EWEA）

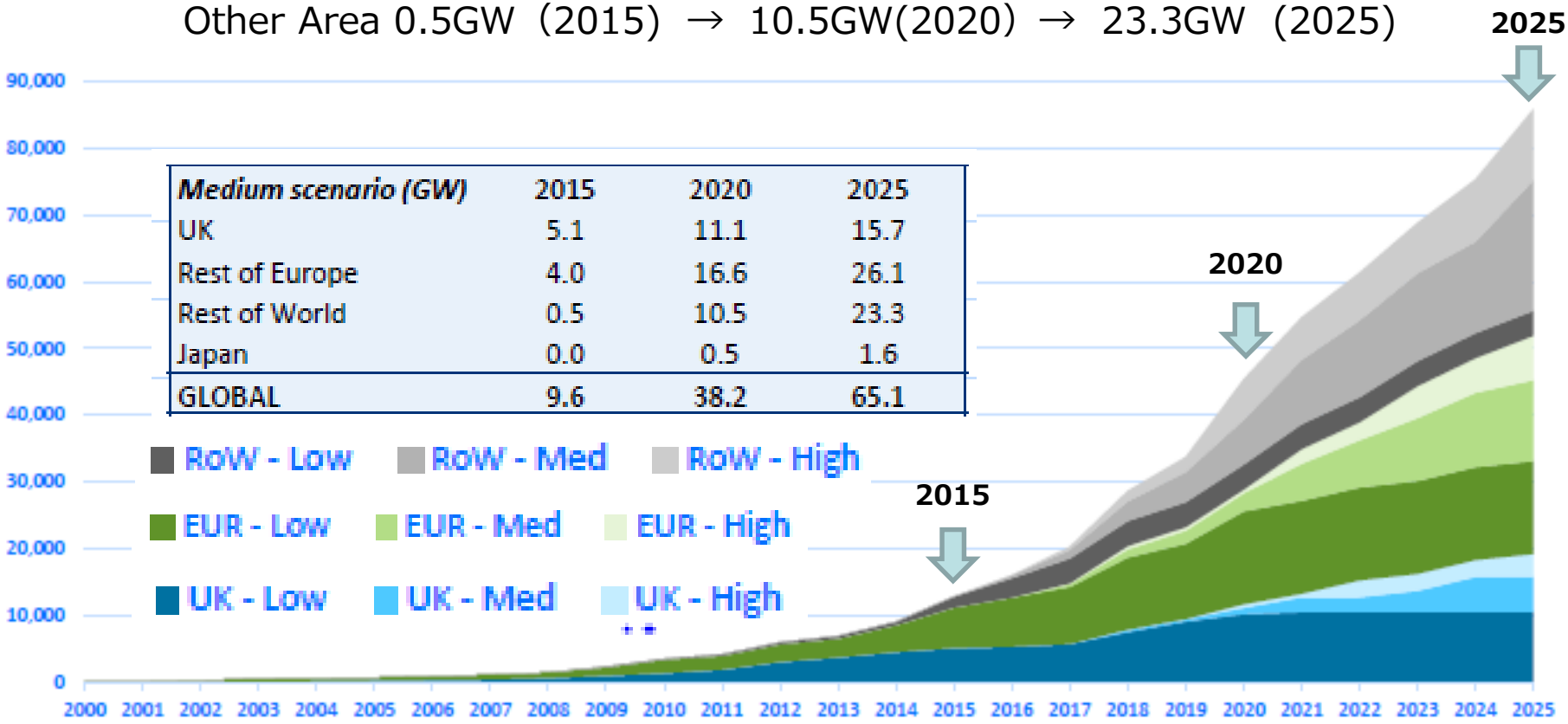
（Source ：DNV GL based on EWEA）

Global Offshore Wind Market until 2025

(2000-2014 2015-2025) (Cumulative Capacity : GW)

Offshore Wind Market will expand globally after 2020 .

World 9.6GW (2015) →38.2GW (2020) →65.1GW (2025)
Europe 9.1GW (2015) → 27.7GW(2020) → 41.8GW (2025)
Other Area 0.5GW (2015) → 10.5GW(2020) → 23.3GW (2025)



Medium scenario (GW)	2015	2020	2025
UK	5.1	11.1	15.7
Rest of Europe	4.0	16.6	26.1
Rest of World	0.5	10.5	23.3
Japan	0.0	0.5	1.6
GLOBAL	9.6	38.2	65.1

Global Offshore Wind Market (Record by 2014 and Estimation after 2015)

(Source: 4offshore, Carbon Trust)

Offshore Wind Construction

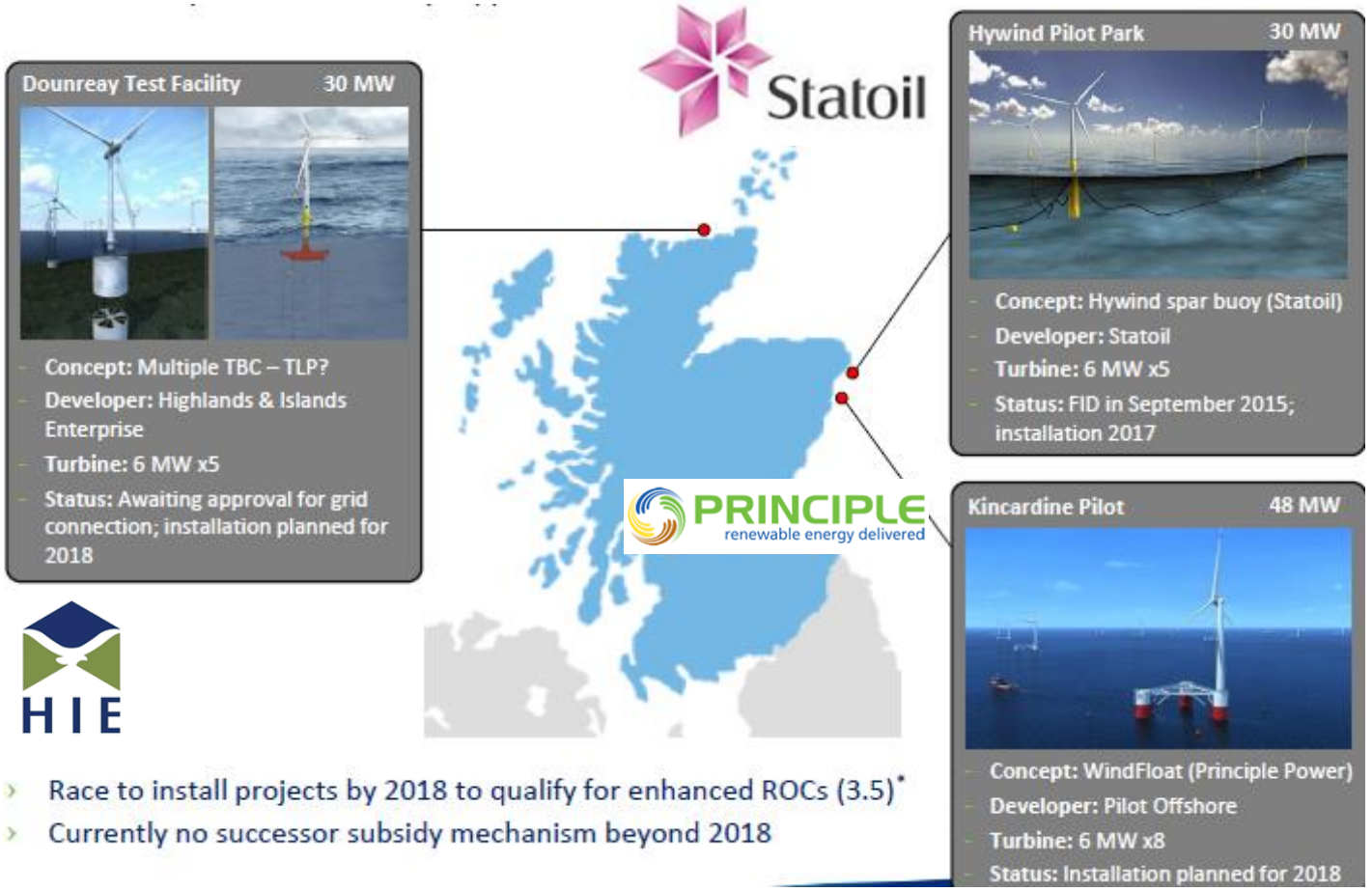
Illustration for construction of Offshore Wind Turbines and Sub Station

(Source: DNV GL)

Floating Offshore Wind Projects in Scotland
(Three projects by 2018)

3.5 ROCs will be available for Floating Offshore Wind in Scotland by 2018.

(Reference) 1 ROC=～£45/MWh (￥8.41/kWh)
3.5ROC＋Wholesale=～£208/MWh (¥38.8/kWh) (Ex. £＝@¥187)



3 Floating Offshore Wind Projects in Scotland (Source: The Carbon Trust)

China

Offshore Wind in China

Inaugurated
In 2010 Donghai Bridge（Shang Hai） 102MW （equivalent to 200mil homes）
In 2012 Longyuan Rudong Inert tidal （Jiangsu Province) 131 MW

Wind farm	Cap. (MW)	Turbines	Where	When	Build Cost	Cap. fac.	Depth range (m)	km to shore	Country	Owner	Refs.
Longyuan Rudong Intertidal	131.3	21 × Siemens 2.3-93 6 × 1.5MW Sinovel various 2 × 3MW; 2 × 2.5MW; 6 × 2MW	32°30'14"N 121°15'36"E	2012	500 million ¥		0 - 8	4	China	owner	[3][4][5]
Donghai Bridge	102	34 × Sinovel SL3000/90	30°46'12"N 121°59'38"E	2010	US$ 102 million		7	16	China	owner	[6][7]

"**Cap.**" is the rated nameplate capacity of the wind farm
"**When**" is the year when the windfarm was commissioned and put into service.
"**Cost**" is the total capital cost of the project up to commissioning.
"**Cap. Fac.**" is the average capacity factor, i.e. the average power generated by the windfarm, as a percentage of its nameplate capacity.
"**km to shore**" is the average distance of the windfarm to shore, or (where available) the distance from the in-farm transformer/substation to the shore
"**Depth range (m)**" is the range of minimum to maximum depths of water that the windfarm is sited in
"**Refs**" cite the source references for the information. The [w ...] footnotes link to each windfarm's own home page

China

Dong Hai Bridge Offshore Wind

Started Operation in June 2010
103MW （3MW x 34）
（Sinovel SL3000-92)
(Equivalent to 200 thousand homes）
Offshore Shanghai
Water depth 7m, 16km from coast.

Country	People's Republic of China
Location	next to Donghai Bridge, Shanghai, East China Sea
Coordinates	30.770°N 121.994°E
Status	Operational
Construction began	July 2008
Commission date	July 6, 2010
Owner(s)	Shanghai Electric Group

China

Longyuan Rudong Inter tidal Wind Farm

Official name	龙源江苏如东150MW海上（潮间带）示范风电场
Country	China
Location	Rudong County, Jiangsu province, East China Sea
Coordinates	30.504°N 121.260°E
Construction began	2011-06-21
Commission date	2012-11-23
Construction cost	500 million ¥
Wind farm	
Type	offshore
Site area	107 km² (41 sq mi)
Max. water depth	8 m (26 ft)
Distance from shore	4 km (2 mi)
Power generation	
Nameplate capacity	150 MW

Demonstration Site
For Chinese wind turbine manufacturers and industries

Started operation in 2012 for total 131MW
（Siemens 2.3MW x 23, Sinovel 1.5MW x 6
Various 3MW x 2, 2.5MW x2, 2MW x 6)
江蘇省如東 Water Depth 0-8m, 4km from coast

China

Longyuan Rudong Intertidal Wind Farm
Expansion Plan

Extending by 49.2MW（Construction 2014~2016）
Aiming for Bigger WTG development by Chinese manufacturers
（Goldwind 3MW x 1, CSIC Haizhuang 5MW x 2, DEC 5.5MW x 1,
Mingyang 6MW x 1, Envision 4MW x 7)

Developers/Owners/Operators

Database as Excel | Add Your Organisation

Role	Organisation
Developer	China Longyuan Power Group Corporation Limited(龙源 电力 集团 股份有限公司) *(China Guodian Corporation (中国国电集团公司))*
	Being developed through subsidiary Jiangsu Offshore Longyuan Wind Power Co., Ltd.江苏海上龙源风力发电有限公司
Owner	China Longyuan Power Group Corporation Limited(龙源 电力 集团 股份有限公司) *(China Guodian Corporation (中国国电集团公司))*
	Being developed through subsidiary Jiangsu Offshore Longyuan Wind Power Co., Ltd.江苏海上龙源风力发电有限公司

Project Details for Longyuan Rudong Intertidal Trial Wind Farm -Extension

Database in Excel

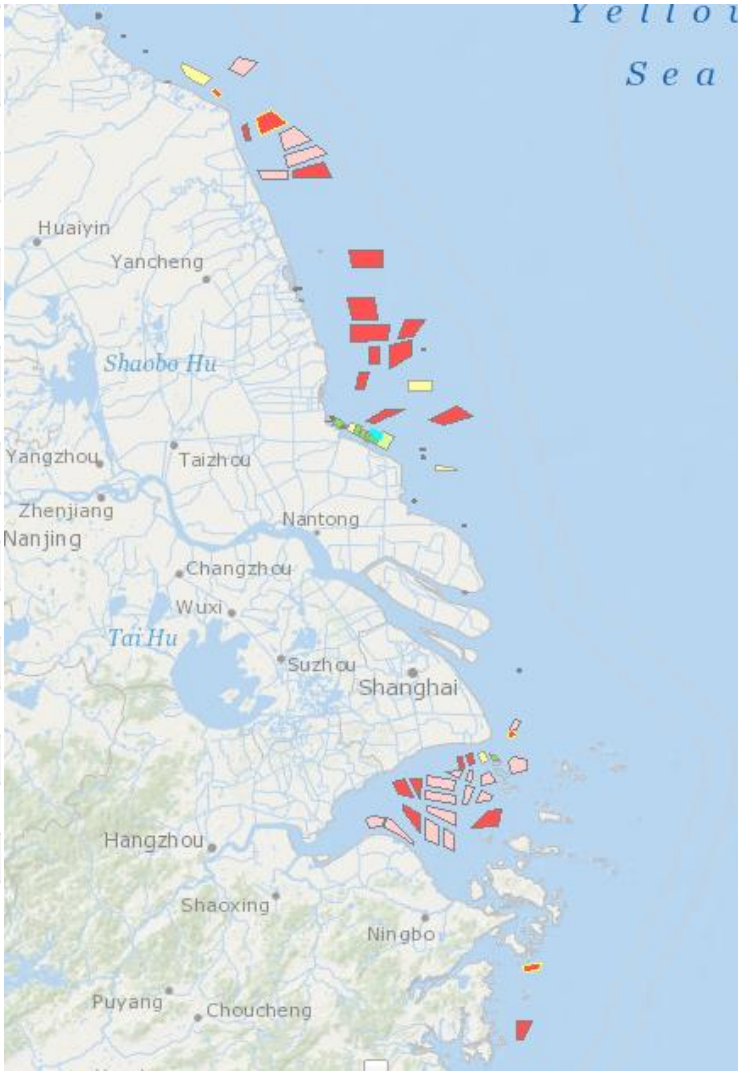
General Information	Name	Longyuan Rudong Intertidal Trial Wind Farm -Extension
	Other names	江苏如东试验风电场扩建项目
	Country name	China
	Region	Jiangsu, Nantong, Rudong
	Comments	The project is included in the 'National Offshore Wind Power Development and Construction Plan (2014-2016)' and, as a result, will be treated by NEA as approved. This means the developers will be responsible for the risks and shall implement all conditions for construciton. Once the sites are qualified to a certain extend they can report to local authorities for approval.
	Round (or category)	2014-2016 development plan
	Development status	Partial Generation/Under Construction
	Comments on the status	

Power & Turbines	*Notice any Errors?*	*You can keep this an open resource by submitting corrections!*
	Project Capacity	49.2 MW
	Turbine Model	Goldwind 3MW x1, CSIC Haizhuang 5MW x 2, DEC 5.5MW x 1, and Mingyang 6MW X 1, Envision 4MW x 7
	Turbine Capacity	
	Number of Turbines	12
	Total Turbine Height	
	Hub Height	
	Rotor Diameter	
	Foundation	Various (Grounded: Monopile+Jacket)
Windspeed	10 Year Mean Wind Speed (2000-2009)	Available online now
Costs	Stated Project Cost	CNY(mill) 790.00
Location & Environment	Sea name	East China Sea
	Centre latitude	32.555°
	Centre longitude	121.233°
	Area	13 km^2
	Depth range (Chart Datum)	0 m - 2 m
	Depth range stated by developer	0 m - 6 m
	Distance From Shore (reported)	4.5 km
	Distance From Shore (computed from centre)	8.5 km

China

Offshore Wind Plans in China

Status	Name
	CPI Binhai South offshore wind farm...
	CSIC Jiangsu Rudong 300MW Offsh...
	Dafeng H3
	Dongtai wind farm - phase 4
	Fengxian
	Fengxian Large Scale
	Fujian Pingtan Datang Changjiangao...
	Fuqing Haitan Strait Intertidal wind fa...
	Fuqing Haitan Strait Offshore wind fa...
	Guangdong Yudean - Xuwen offshor...
	Guangdong Yudean Zhanjiang Wailu...
	Hainan Dongfang Offshore Windfarm
	HEC Lamma Offshore Wind Farm
	Hong Kong Offshore Wind Farm in S...
	Huadian and Mingyang
	Huadian Caofeidian Offshore Wind F...
	Huadian Yuhuan Offshore Wind Far...
	Huaneng Dafeng Intertidal C4 Wind...
	Huaneng Rudong Offshore Wind Far...
	Huaneng Yangjiang Shapa Offshore...
	Huayuankou
	Jiangsu Longyuan Dafeng Offshore...
	Jiangsu Longyuan Dafeng Offshore...
	Jiaxing 1 Offshore Wind Power Project
	Jiaxing 2 Offshore Wind Power Project
	Jiaxing 3 Offshore Wind Power Project
	Laoting Bodhi Island Offshore Wind...
	Laoting Yuetuo Island Offshore Wind...
	Longyuan Putian Nanri Island 400M...
	Longyuan Putian Nanri Island 400M...
	Nantong Haian Xiehe 47.5MW windf...
	Pingtan experimental zone 300MW o...
	Powerchina Rudong C1 Offshore Wi...
	Putian Pinghai bay offshore project p...
	Putian Pinghai bay offshore Wind Fa...
	Sheyang Offshore Concession Project
	Sinohydro Tianjin Nangang Offshore...
	Sinohydro Tianjin Nangang Offshore...
	Xiangshan 1 Offshore Windfarm - ph...



Offshore Wind in Japan

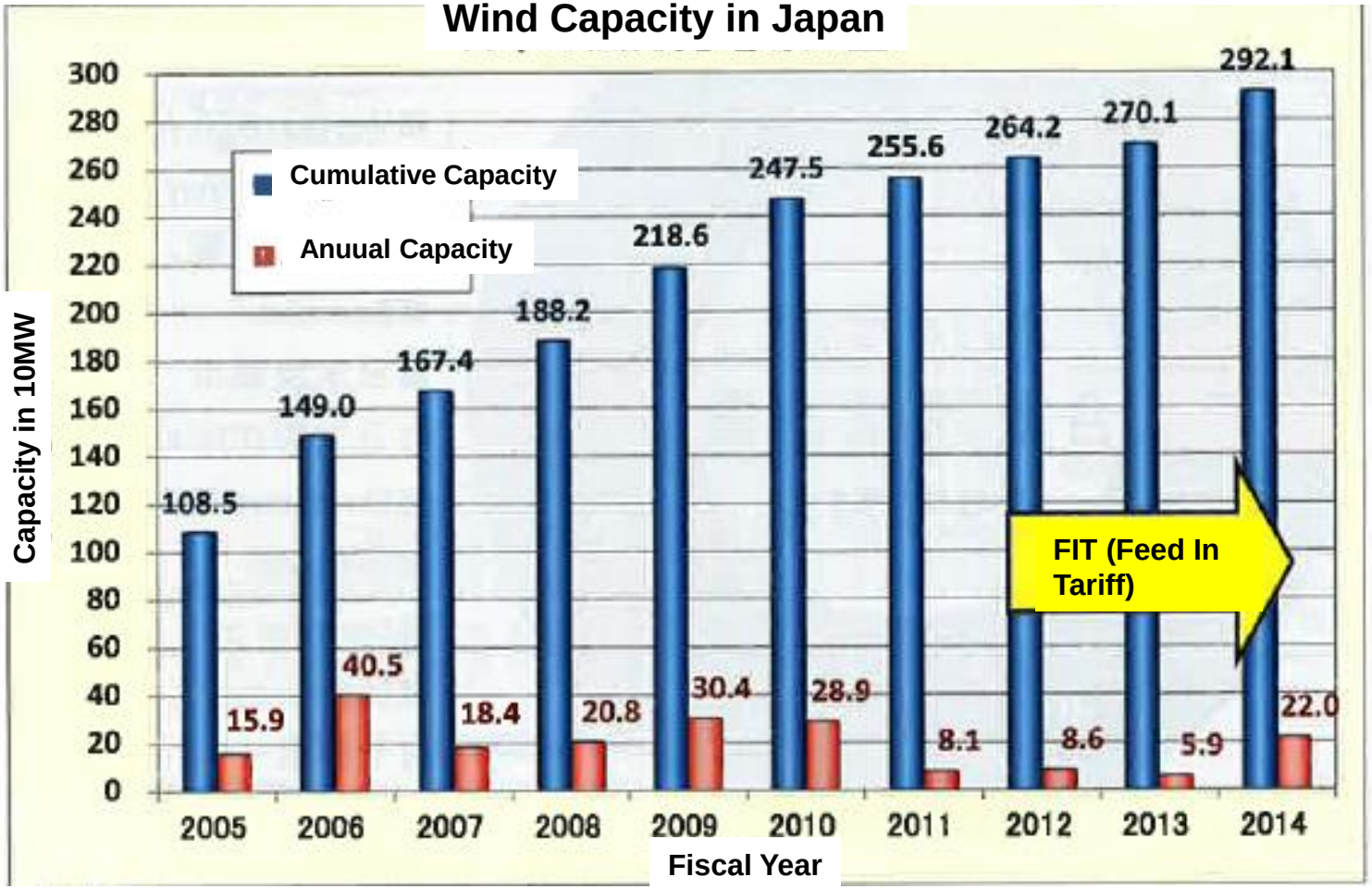
Full scale BOW Test 3km offshore Choshi city, Chiba Prefecture
Carried out by NEDO & TEPCO since 2010 with 2.4 MW WT.

Wind capacity in Japan
2005 – 2014 (FY)

Blue : Cumulative Capacity (10MW) ※292means 2.92GW

Red : Annual Installed Capacity (in same scale)

Source : JWPA

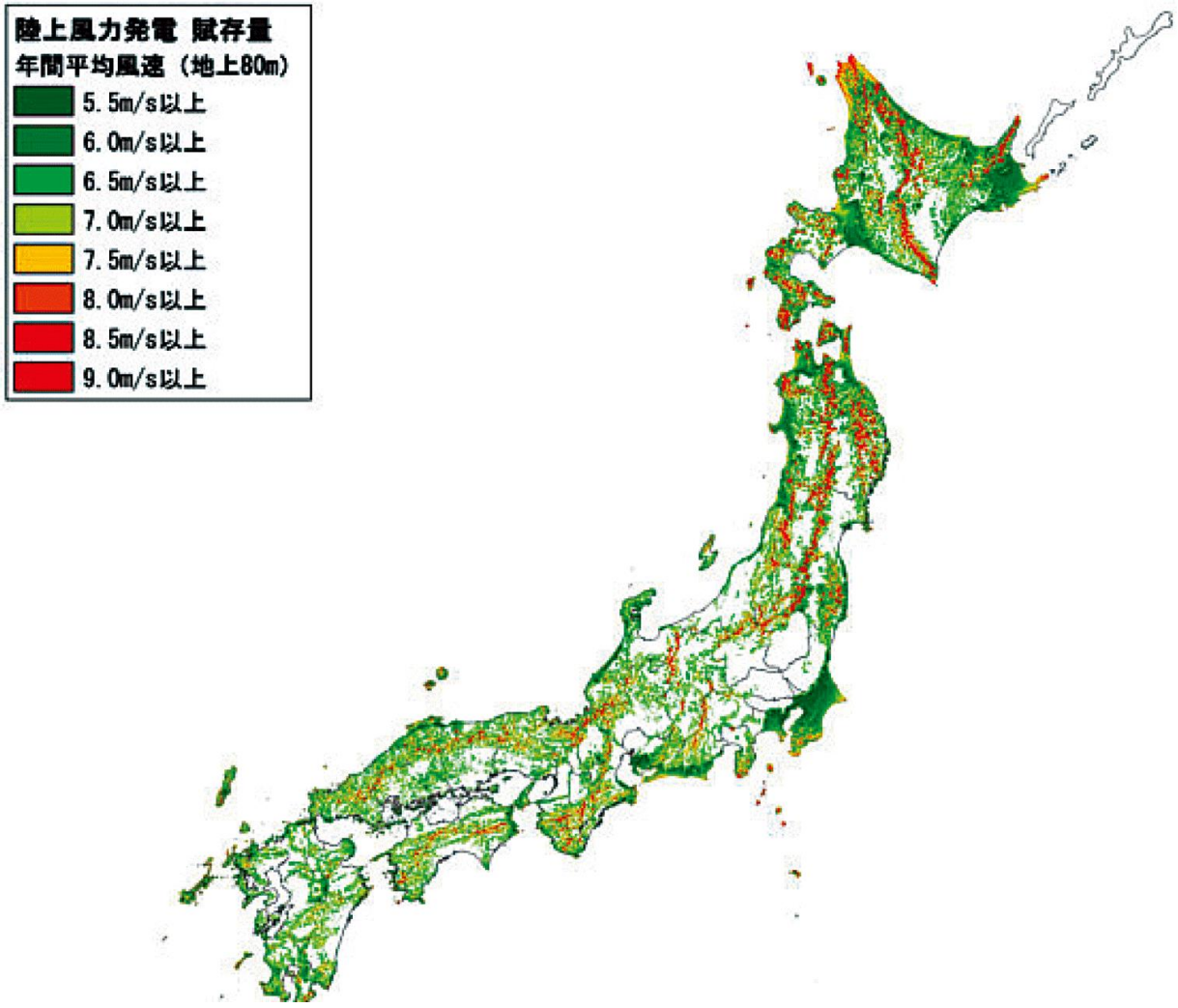


Onshore Wind

Wind Resources in Japan

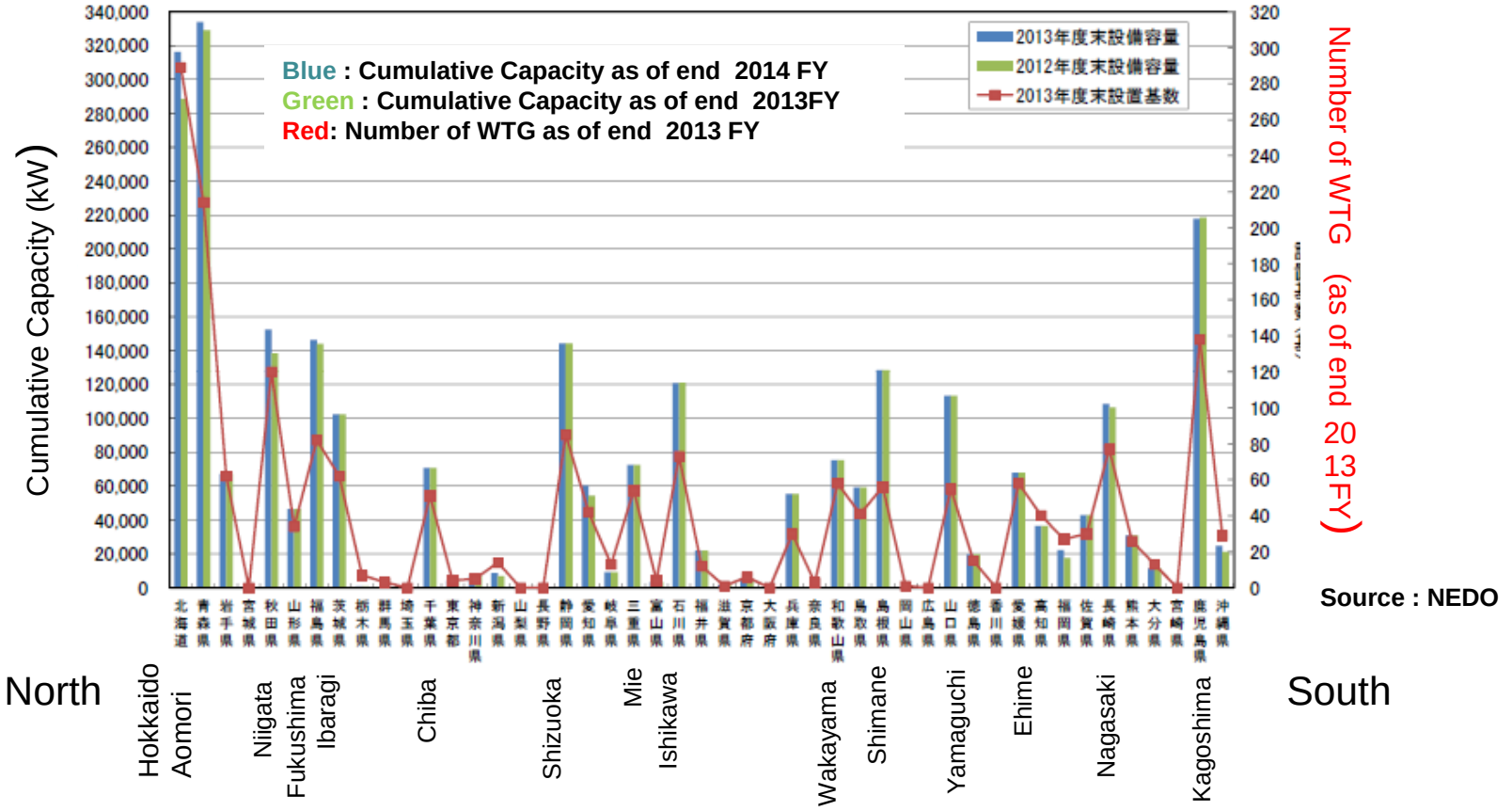
Average Wind Velocity at 80 meter above ground.

Source : NEDO



Onshore Wind

WTG Local Capacity by Prefecture
From North to South in Japan



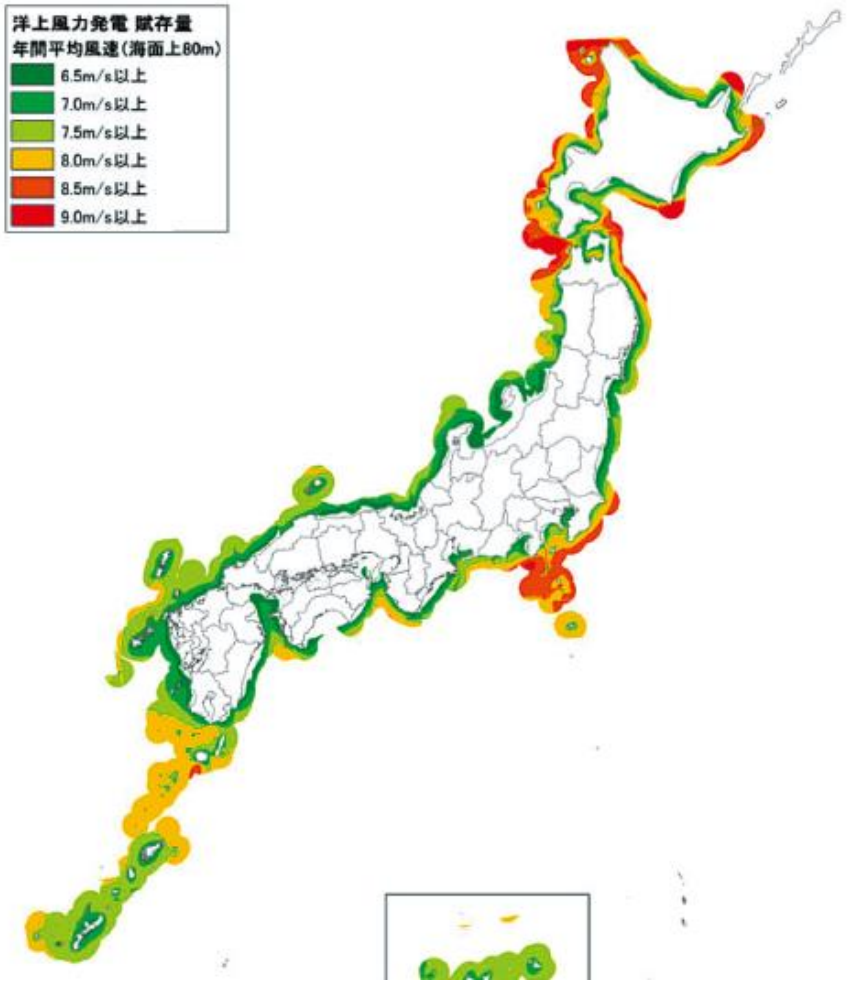
From Left to Right, from North to South by Prefecture

From Left, Hokkaido, Aomori, Iwate, Miyagi, Akita, Yamagata, Fukushima, Ibaragi, Tochigi, Saitama, Chiba, Tokyo, Kanagawa, Niigata,Yamanashi, Nagano Shizuoka, Aichi, Gifu, Mie, Toyama, Ishikawa, Fukui, Shiga, Kyoto, Osaka, Nara, Wakayama.

From Right, Okinawa, Kagoshima, Miyazaki, Oita, Kumamoto, Nagasaki, Saga, Fukuoka, Kochi, Ehime, Kagawa, Tokushima, Yamaguchi, Hiroshima, Okayama, Tottori, Shimane, Wakayama.

Near Shore Wind Resources in Japan

Average Wind Velocity at 80 meter above water.

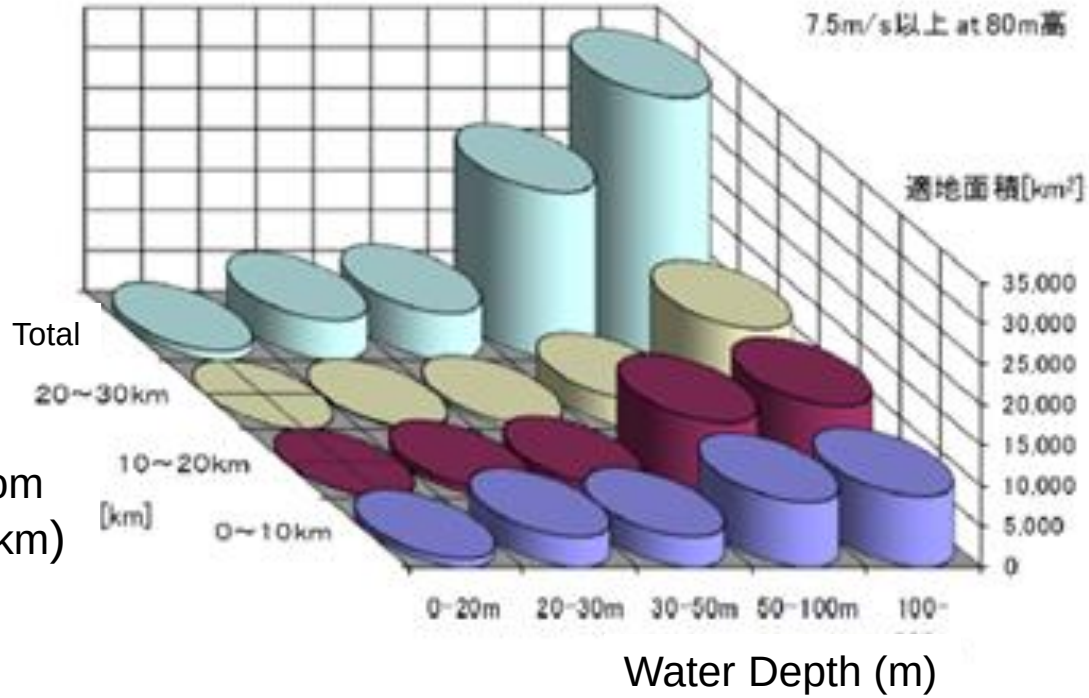


Source : NEDO

Offshore Wind Potential in Japan

Deep sea good for Floating Offshore Wind : 519 GW
Shallow sea good for Bottom Fixed Wind : 93 GW
Total 612 GW which is 3 times bigger than total power capacity in Japan

Sea Area with averaged wind speed exceeding 7.5m/sec at 80m height



Source: JWPA

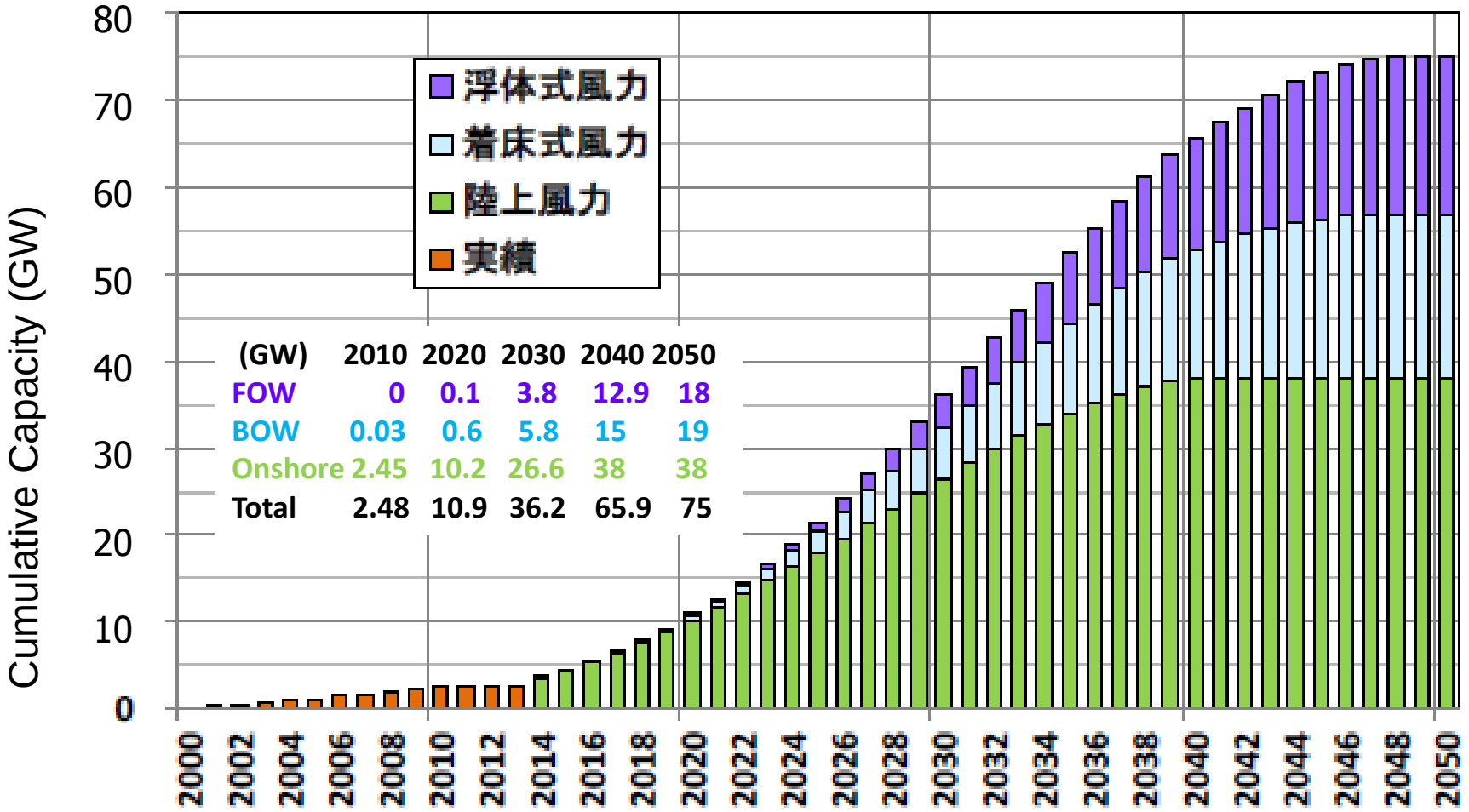
Source: JWPA

20GW Offshore Wind can provide about 5% of Japanese electricity demand.

Wind

Wind Road Map (vision) by JWPA

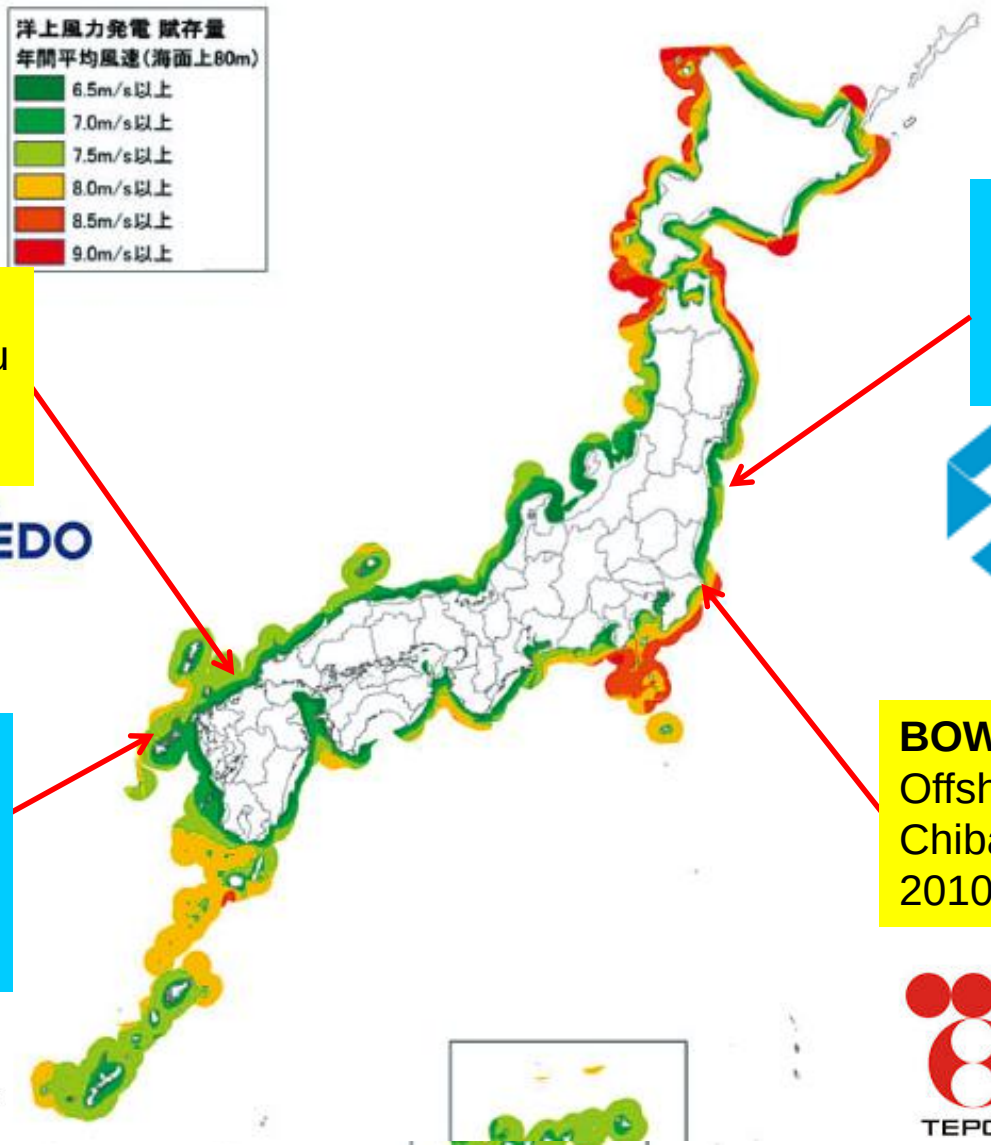
(Japan Wind Power Association)



JWPA published challenging Vision toward 2050

Source: JWPA

Offshore Wind Full Scale Test



BOW 2 MW
Offshore Kita Kyushu
Fukuoka Prefecture
2010-2015

J-POWER NEDO

FOW 2MW, 7MW, 5MW
Offshore Fukushima
Fukushima Prefecture
2011-2016

経済産業省
Ministry of Economy, Trade and Industry

FOW 2MW
Offshore
Kabashima Island
Nagasaki Prefecture
2012-2015

環境省
Ministry of the Environment

BOW 2.4 MW
Offshore Choshi
Chiba Prefecture
2010-2015

TEPCO NEDO

Offshore Wind

BOW Full Scale Test

3km offshore Choshi city, Chiba Prefecture
Since May 2010

Joint Program between

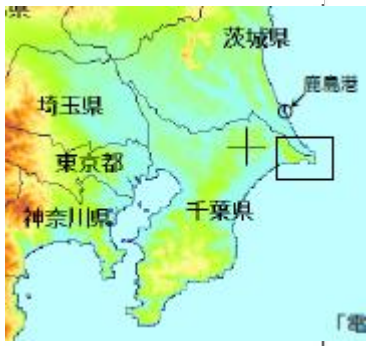
NEDO

TEPCO

(Tokyo Electric Power Co)

Location : 3km Offshore (water depth 12m) offshore
Choshi city, Chiba Prefecture
Rotor diameter : about 92 m (2.4MW)
Test period; from May 2010 until Feb 2015
Development Cost : About 3.5 billion Japanese Yen (US$ 35 mil)
NEDO support two third of the project cost.

Full Scale Test



Offshore met mast and wind turbine (BOF)

Offshore Wind

BOW Full Scale Test

1.4 km offshore Kita-kyushucity, Fukuoka Prefecture
Since August 2011

Joint Program between

NEDO

J-POWER

Location : 1.4km offshore (water depth 14m)
off Kitakyushu city, Fukuoka Prefecture, Kyushu Island
Rotor diameter : approx. 83m (2MW)
Test period ; from August 2011 until Feb 2015
Development Cost : About 3.5 billion Japanese Yen (US$ 35 mil)
NEDO support two third of the project cost.

Full Scale Test

Offshore met mast and wind turbine (BOF)

Offshore Wind

環境省
Ministry of the Environment

FOW Full Scale Test by MOE

1km Offshore Kabashima island, Goto City, Nagasaki Prefecture
Since 2012 (100kw) & 2013 (2MW)

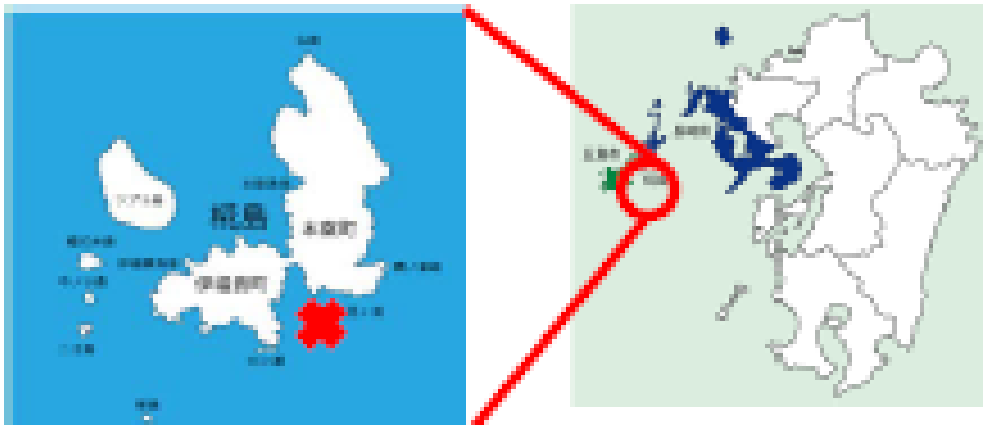
2012 WTG 100kW

EIA study : 2011-2015 FY
Feasibility Study : 2015 FY

WTG HITACHI Inspire the Next

Hybrod Spar
Steel & Concrete

Hitz Hitachi Zosen 戸田建設 TODA CORPORATION



2013 WTG 2MW
& Floating Met Mast

Offshore Wind

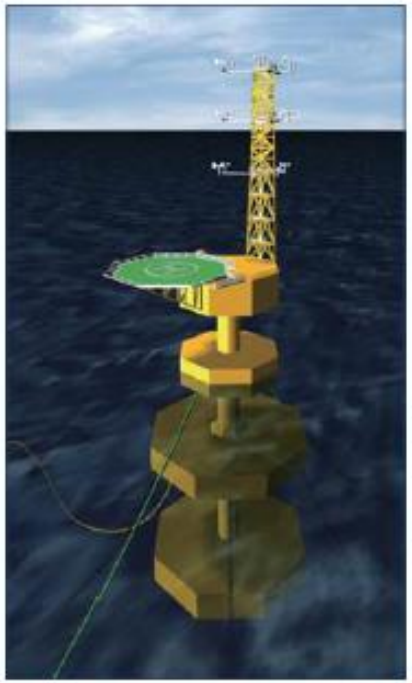
FOW Full Scale Test by METI

20km Offshore Fukushima Prefecture

経済産業省 Ministry of Economy, Trade and Industry

http://www.fukushima-forward.jp/english/news_release/news150622.html

Phase Ⅰ (2011～2013) | Phase Ⅱ (2014～2015)

Floating Substation (SS 25MW) 2013	Compact semi-sub (WTG 2MW) 2013	Advanced Spar (WTG 5MW) 2016	V shape semi-sub (WTG 7MW) 2015
			
WTG: HITACHI Inspire the Next	WTG: HITACHI Inspire the Next	WTG: HITACHI Inspire the Next	WTG: MITSUBISHI HEAVY INDUSTRIES, LTD.
Float: JMU Japan Marine United Corporation	Float: MES 三井造船	Float: JMU Japan Marine United Corporation	Float: MITSUBISHI HEAVY INDUSTRIES, LTD.

Fukushima FOW Test

2MW WTG installed in 2013

Operation from November 2013

Offshore Wind

Fukushima FOW Test

25 MW Floating SS installed in 2013

Water tank test

By using a scaled model of 2MW compact semi-submersible floater, water tank test was carried to clarify the response of the floater under design wind, wave and current conditions on April, 2013. The optimum control method during power production for floating wind turbine was also investigated. A dynamic analysis model of FOWT is validated by comparing with the water tank test and onsite measurement data.

Metocean measurements

The floating substation is equipped with met-ocean measurement devices. Wind velocities are measured by using cup anemometers, wind vanes and sonic anemometers on the met mast, and the doppler lidar on the main deck. The wave and current are measured by using the wave meter and ADCP on the middle hull. The floater motion is also measured with accelerometers, GPS and gyros on the main deck, and a floater motion compensation algorithm is also developed.

MHI 7MW WTG (Sea Angel)

Rotor Diameter : 157 m

V-Shape Semi Sub for 7MW WTG

Towed from Nagasaki to Onahama port, Fukushima Prefecture
30Oct-10Nov 2014

FOW Schedule in 2015

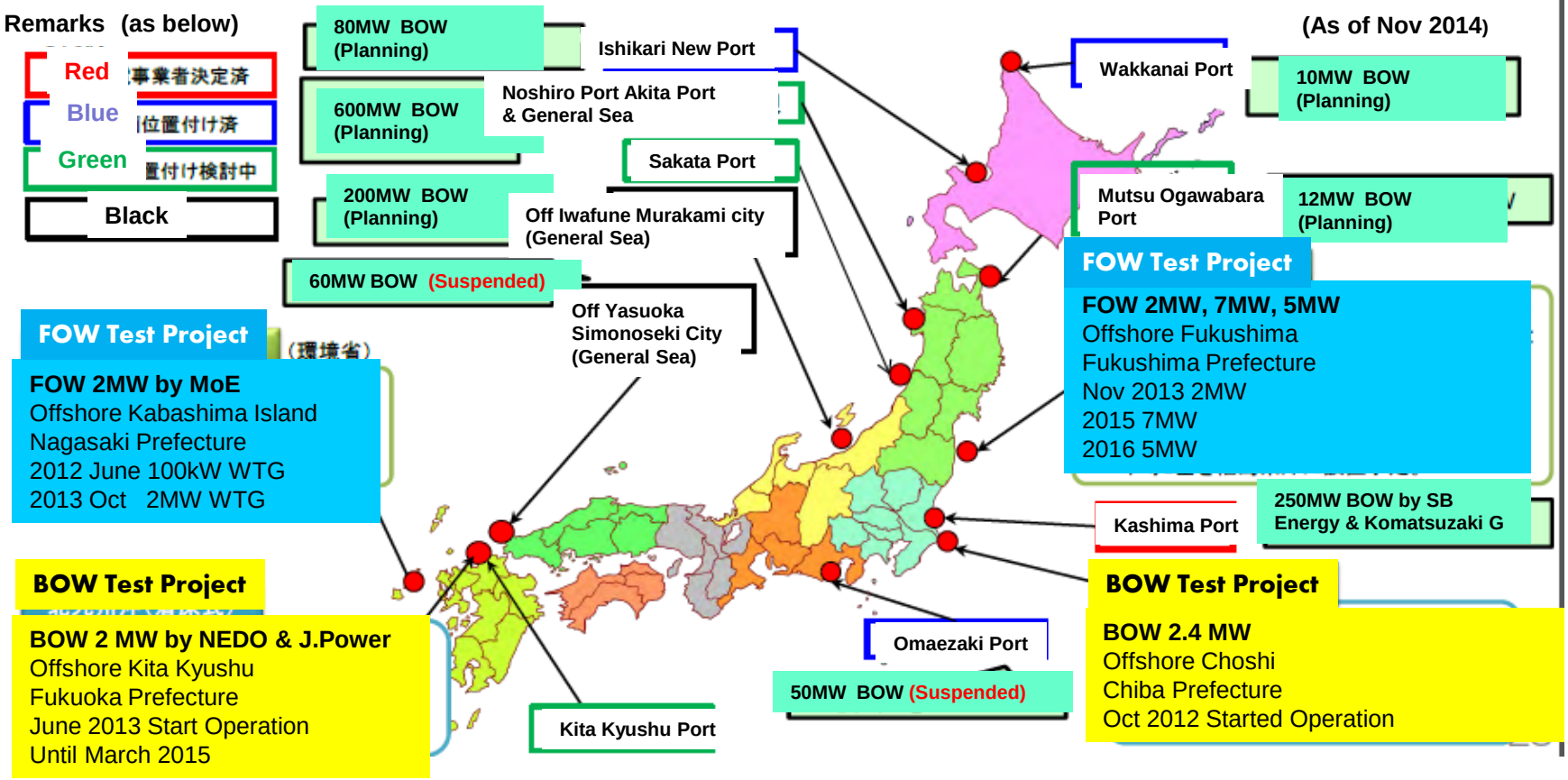
July – September Offshore Installation
December Starting Operation

(Source: METI, Fukushima FORWARD)

Offshore Wind

Offshore Wind Plannings

Offshore wind is inevitable in Japan because onshore potential is limited.
There are two BOW test projects offshore Choshi, Chiba and offshore Kita-Kyushu, Fukuoka.
There are also two FOW test projects offshore Fukushima and Goto Islands, Nagasaki. **(Source: METI)**



Remarks

Red : Developer has been determined, **Blue**: Registered in Port Plan
Green: Under study in Port Plan, **Black**: Others

FIT

FIT for Offshore Wind in Japan

Newly introduced from April 2014

(Tax exclusive, per kWh)

		2013FY	2014FY	2015FY	Duration
Wind	Onshore Wind	Yen 22	Yen 22	Yen 22	20 years
	Offshore Wind	---	Yen 36	Yen 36	20 years
Solar PV	smaller than 10kW (house)	Yen 38	Yen 37	(*1) Yen33 / Yen 35	10 years
	10kW or larger	Yen 36	Yen 32	(*2) Yen 29/ Yen 27	20 years
Geothermal	smaller than 15MW	Yen40	Yen 40	Yen 40	15 years
	15MW or larger	Yen26	Yen 26	Yen 26	15 years
Biomass derived	Biogas (Methane)	Yen 39	Yen 39	Yen 39	20 years
Wasted Biomass	smaller than 2MW	Yen 32	Yen 32	Yen 40	20 years
	2MW or larger	Yen 32	Yen 32	Yen 32	20 years

Additional Charge for FIT in 2015 FY : fixed at Yen 1.58/kWh
(Average consumption per household in Japan : 300kWh/month)

Remarks on Solar PV
(*1) need conditioner ¥29
(*2) April-June ¥29
July-March ¥27

CoE

Cost of Energy in 2010 & 2030 in Japan

JWPA Model (as of 2014)

(CoE : ¥/kWh)	2010	2030
・Big Scale Onshore Wind :	10	
・Onshore wind	9.9-17.3	8.8-17.3
・Offshore wind	9.4-23.1	8.6-23.1
Coal	9.5	10.3
Nuclear	8.9	
Hydro	10.6	

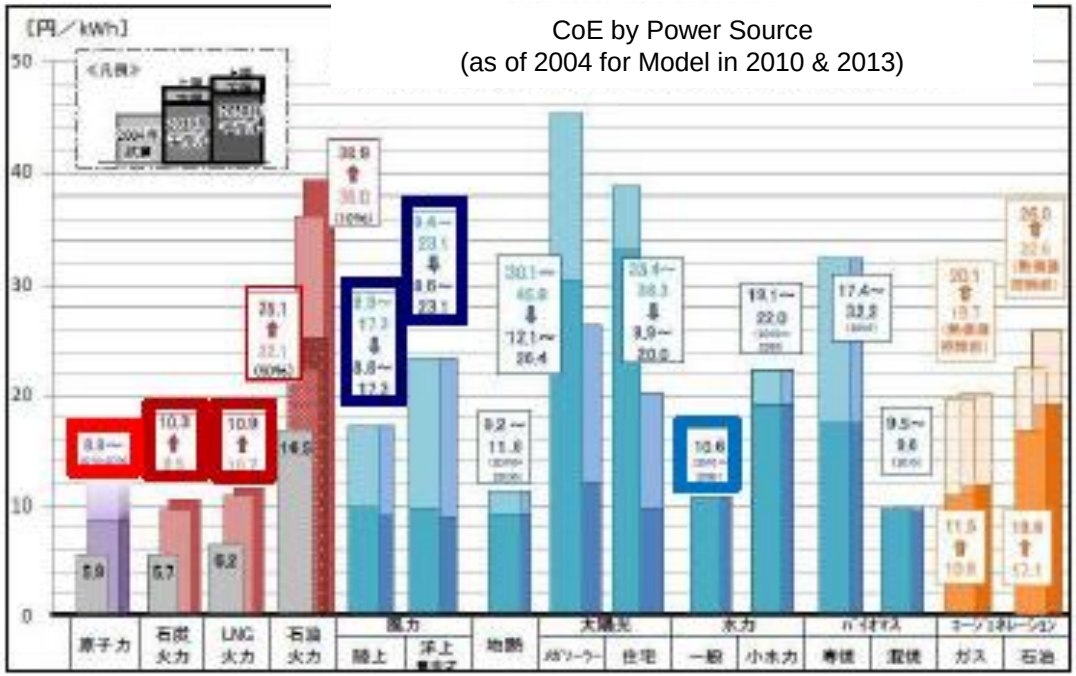
NEDO

White Paper on RE Tech (Ver.2 Feb 2014)

(CoE : ¥/kWh)	2020	2030
・Onshore wind	7-11	5-8
・Offshore wind	12-17	8-11

http://www.nedo.go.jp/content/100116324.pdf
http://www.nedo.go.jp/content/100544818.pdf

CoE by Power Source
(as of 2004 for Model in 2010 & 2013)



Nu Coal LNG Oil Wind Geo-T PV Hydro Biomass Co-Gene
OnS OffS Mega House Big Small Gas Oil

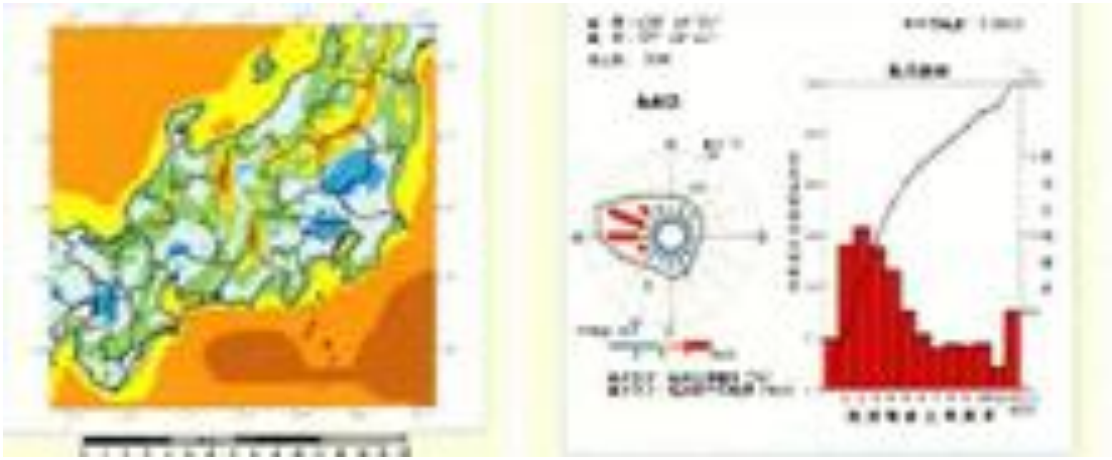
JWPA (2014)
CoE by big scale onshore wind farm could be in the same range of CoE by Coal or Nuclear

METI (2014)
CoE by big scale wind farm could be the same of CoE by Coal.

Wind Simulation Model in Japan

Offshore Wind Map

- Tentative plan for FY 2015 – FY 2016 by METI
- Preparation of Simulation Model of offshore wind from weather simulation and satellite data.
- Image of Output of Map



(Left) Average wind speed (Right) Wind model on each site

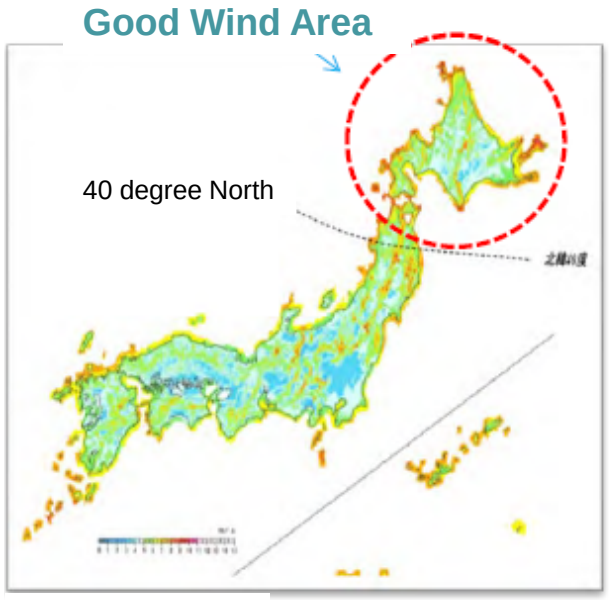
- Wind Map with 500m mesh from onshore to offshore by utilizing current available data

GRID

Wind vs Grid

Good wind area locates north.
More than latitude 40 degree North.
However Grid is weak in such area due to small demand of electricity.

Wind and Grid in Japan



(Source) NEDO

Grid Access Capacity for Wind
(10MW)

	Grid Access Capacity for Wind	**Connected** As of March 2013
Hokkaido	56	31.6
Tohoku	200	56.5
Tokyo	NA	37.1
Chubu	NA	22.4
Hokuriku	45	14.6
Kansai	NA	7.8
Chugoku	100	29.9
Shikoku	60	16.6
Kyushu	100	36.5
Okinawa	2.5	1.4
Total	563.5～	254.4

(Source) Each EPCO

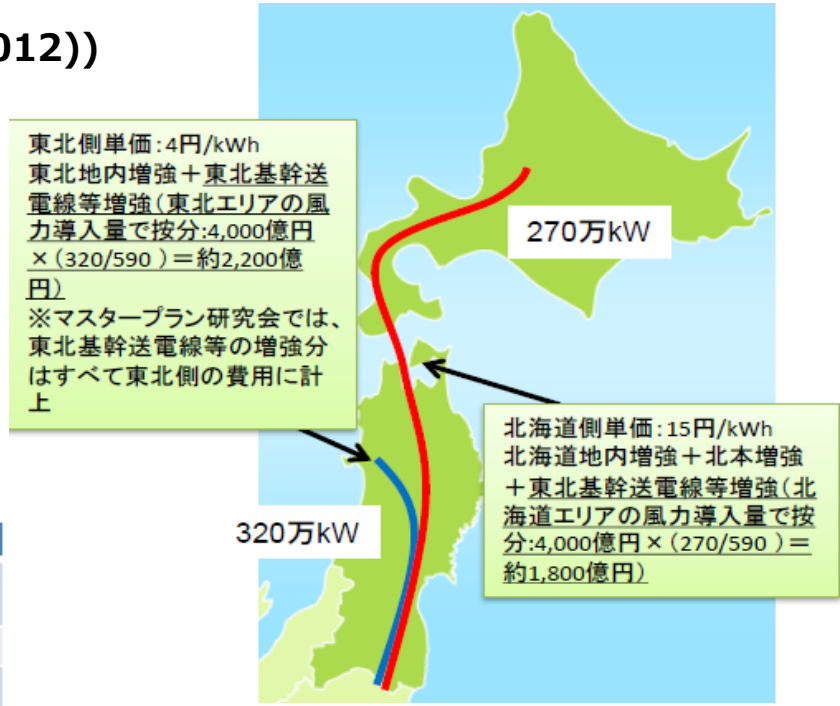
GRID

Cost Study for GRID Strengthen by committee in Japan

Cost Study for GRID Strengthen

Example for cost study by Japanese Government
(Energy Committee March 2015 (Based on April 2012))
★ J.Yen 1.17 tri (€8.6 bil) for 5.9GW
(J.Yen 200 mil (€1.5 mil) for 1MW)

Case study
New Wind 2.7 GW in Hokkaido Island
Transport down south to Tokyo by GRID Strengthen in Hokaido & Tohoku Area
Annual Cost Up J.Yen @¥9/kWh
To be shared by Hokkaido Area @¥5/kWh & Tohoku Area @¥4/kWh



＜一定の仮定に基づく風力の追加導入量における追加費用＞

	北海道(風力)	東北 (風力)	北海道+東北 計
追加連系量	270万kW（47億kWh/年）	320万kW（56億kWh/年）	590万kW（103億kWh/年）
地内送電網増強	2,000億円程度	700億円程度	2,700億円程度
地域間連系線・地内基幹送電線増強等	6,800億円程度【＋1,800億円】	2,200億円程度【－1,800億円】	9,000億円程度
概算工事費計	8,800億円程度［15円/kWh程度］	2,900億円程度［4円/kWh程度］	1兆1,700億円程度［9円/kWh程度］

Rule on utilization of Grid shall be discussed in guide line of OCCTO.

EMR

Electric Market Reform in Japan

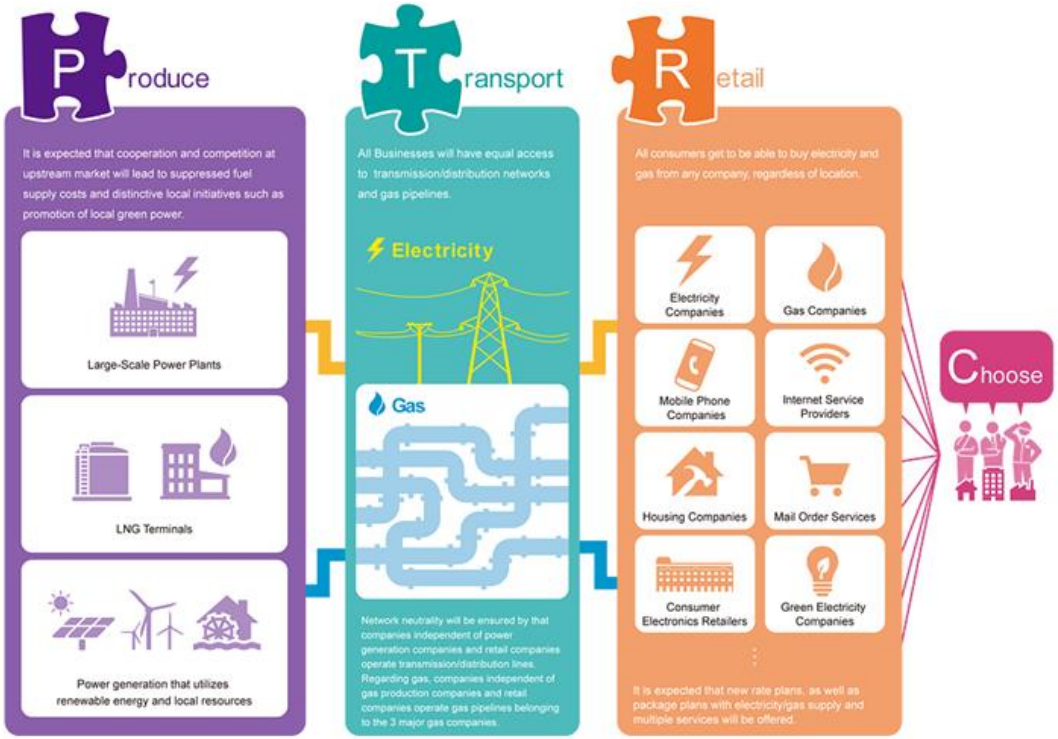
We create a new comprehensive and competitive energy market in Japan, by removing barriers in vertically integrated market. We aim to accomplish the following two goals:

1) Driving growth in Japan

Nurture dynamic innovation including combination of different services and development of revolutionary industrial technology

2) Enhancing consumer benefits

Enhance benefits for consumers including an expansion of energy choices, keeping energy prices to a minimum, ensuring a stable supply of energy, and securing overall safety.

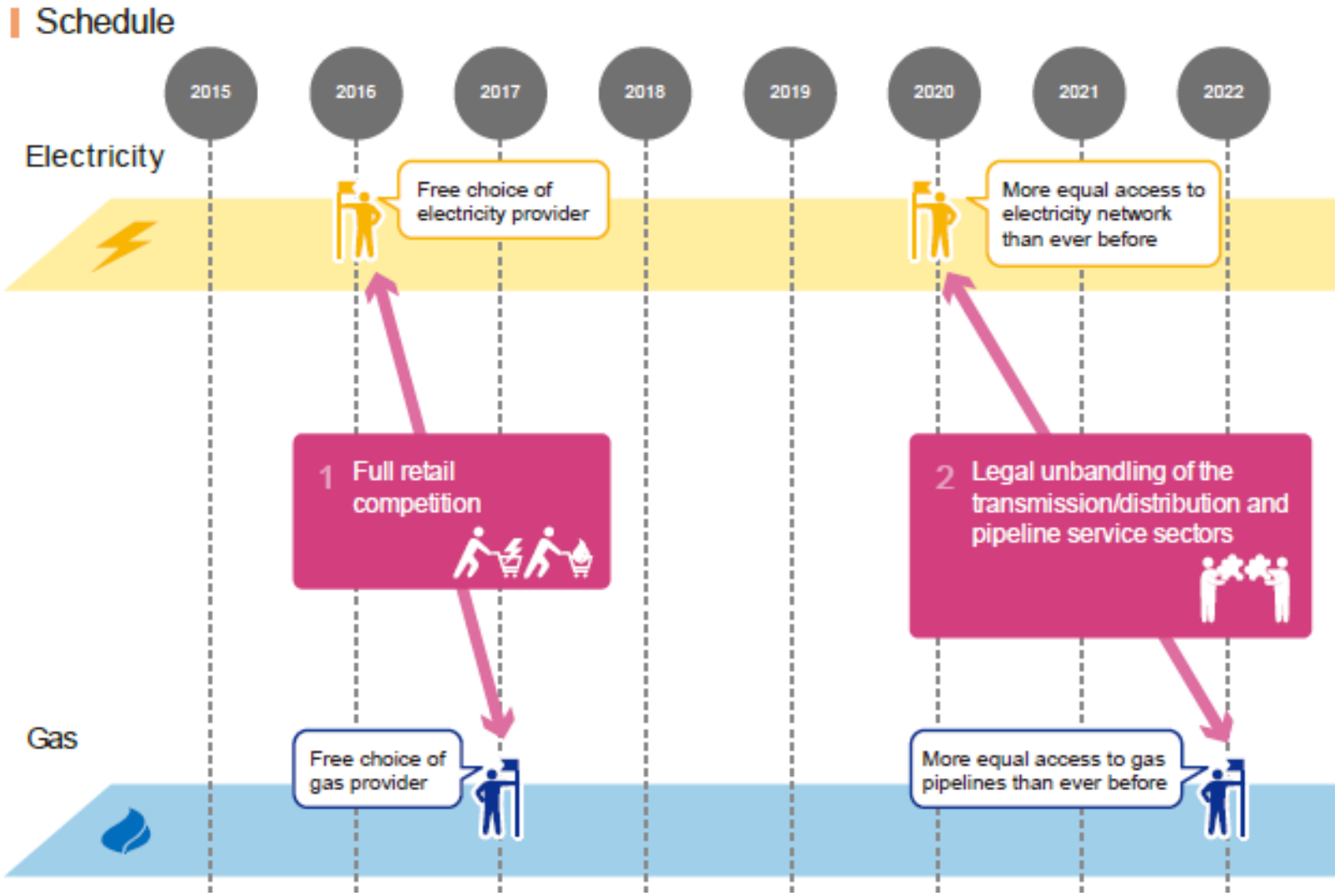


METI
Ministry of Economy, Trade and Industry

Agency for Natural Resources and Energy

EMR

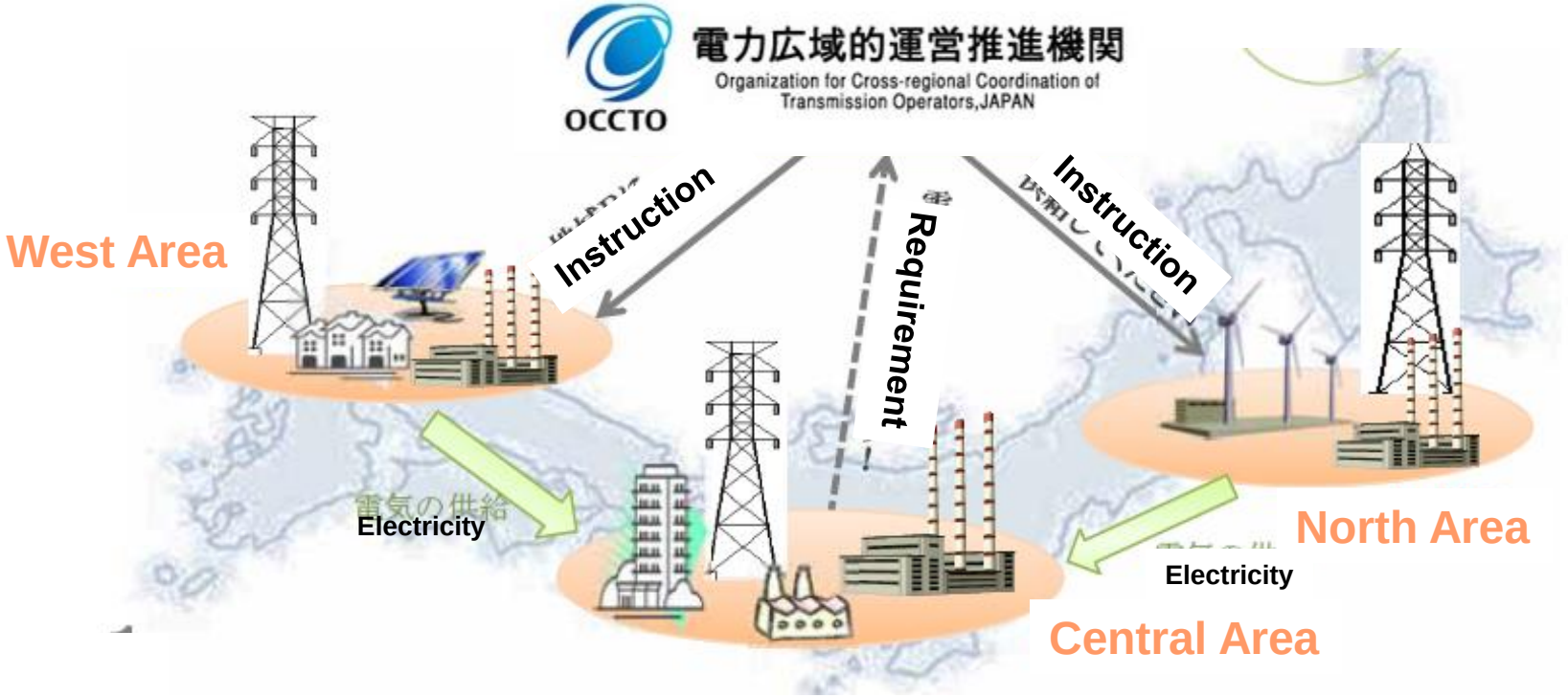
Electric Market Reform in Japan
Schedule



EMR

Electric Market Reform in Japan
OCCTO
(Organization for Cross regional Coordination of Transmission Operators, Japan)

OCCTO has established in April, 2015.



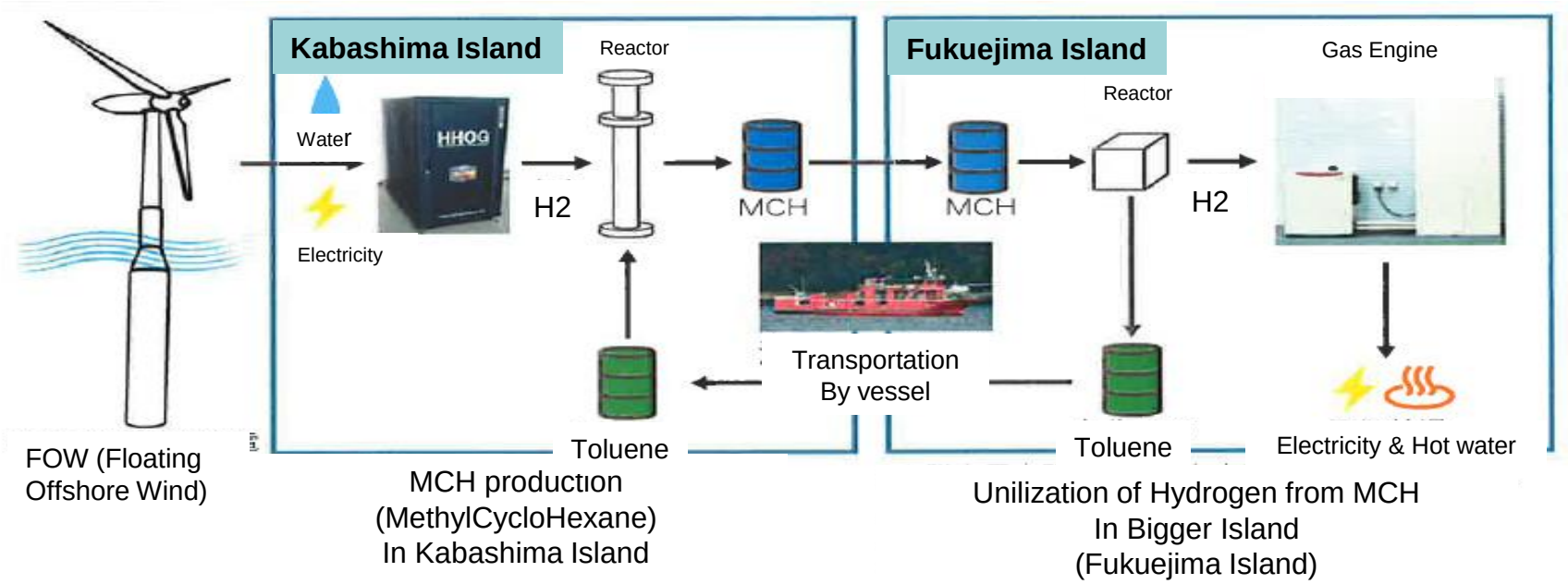
(Reference)

1. Transmission between Tohoku EPCO and Tokyo EPCO (as of FY 2012)
   Transmission capacity is 12.62 GW
   Operation to Tohoku EPCO 4.7 GW and to Tokyo EPCO 0.6GW.

2. It is estimated **1,170 billion Yen** (about US$ 10 billion) to **reinforce grid for additional 5.9 GW Wind** in Hokkaido and Tohoku area. (Energy committee under Government in March 2015)

Hydrogen

FOW & MCH Transportation



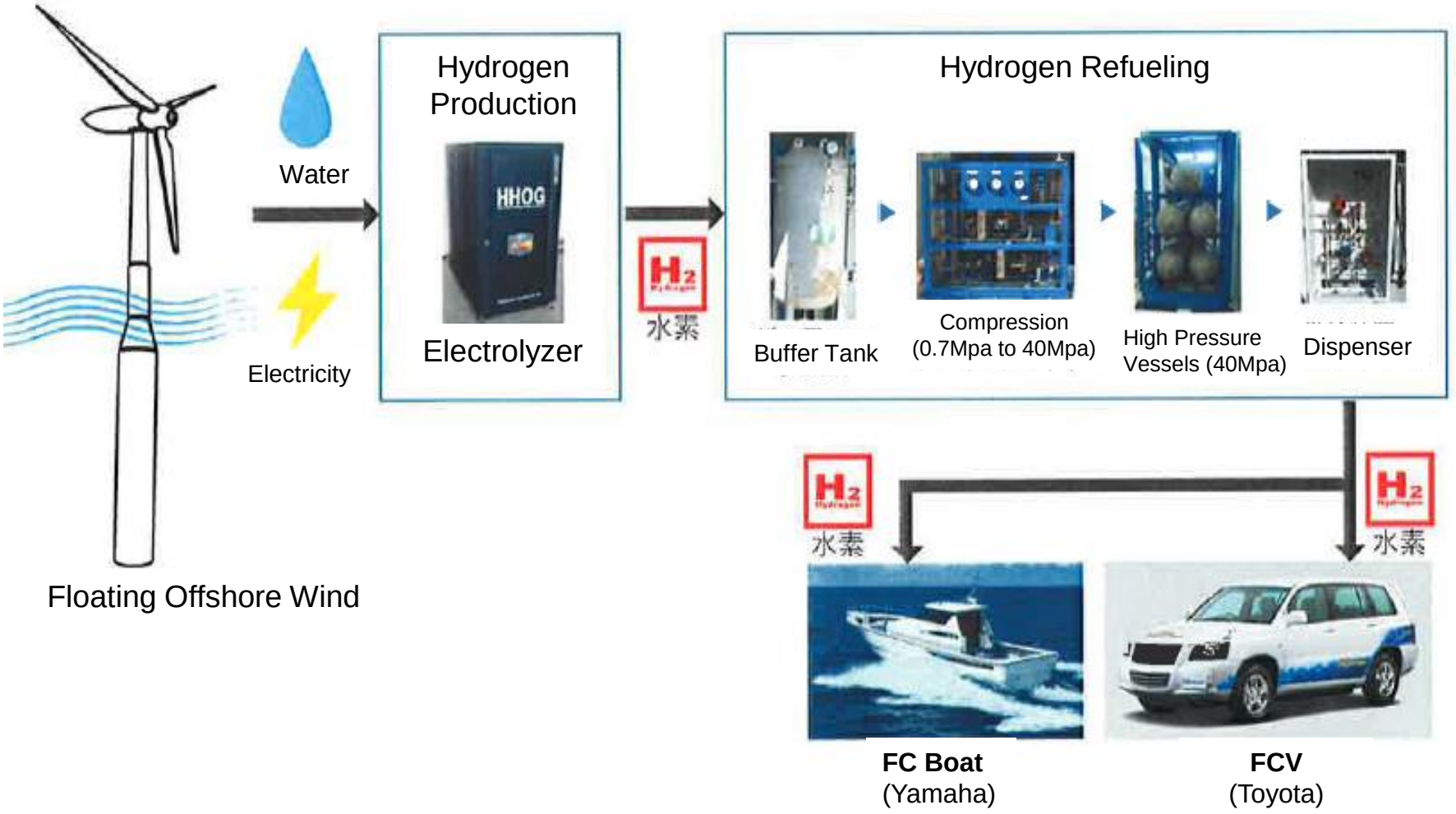
H2 & MCH

Cost for Production Transportation Utilization

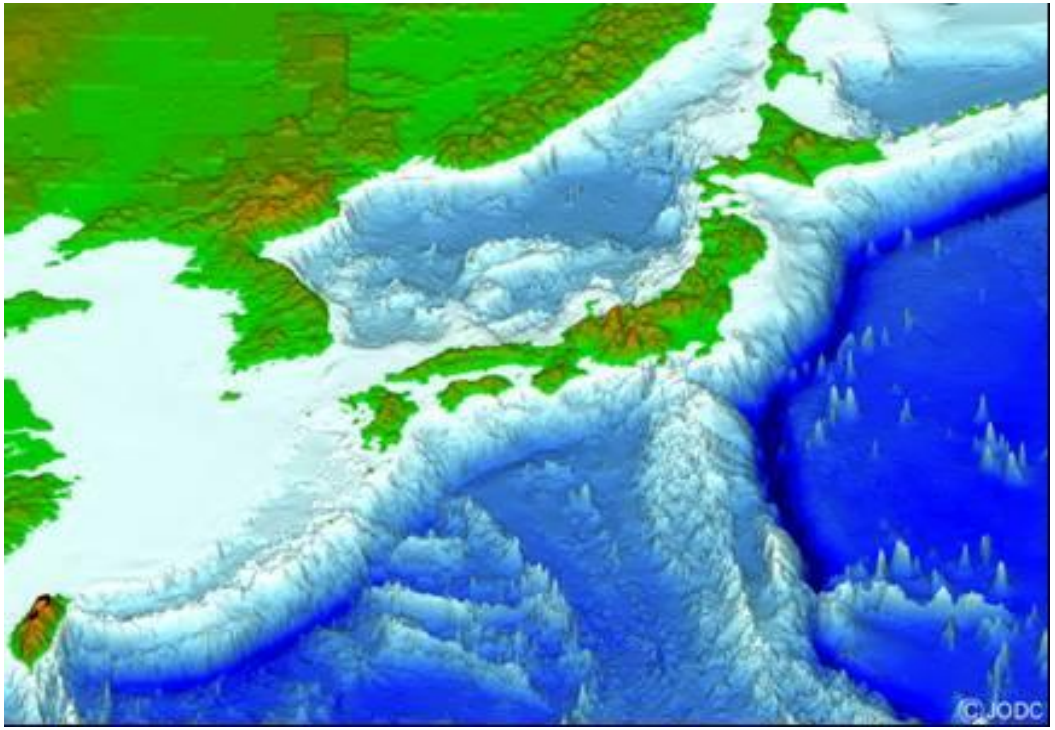
FOW

Cost for SS & Exporting Subsea Cable

FOW & Hydrogen Utilization

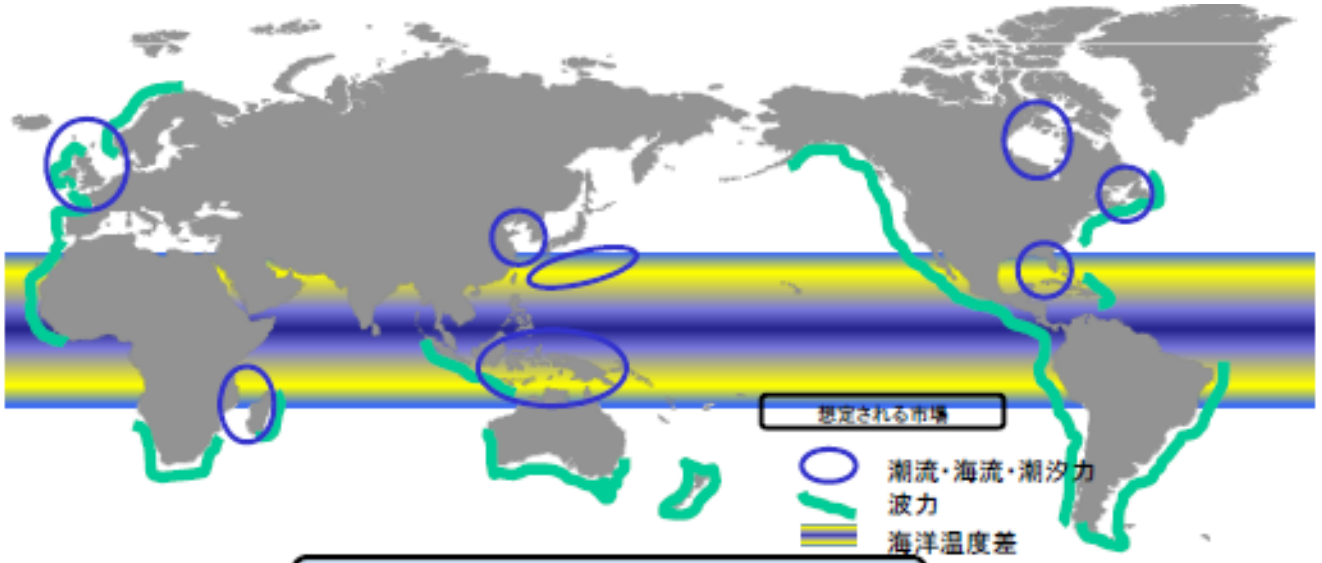


Ocean Renewables in Japan

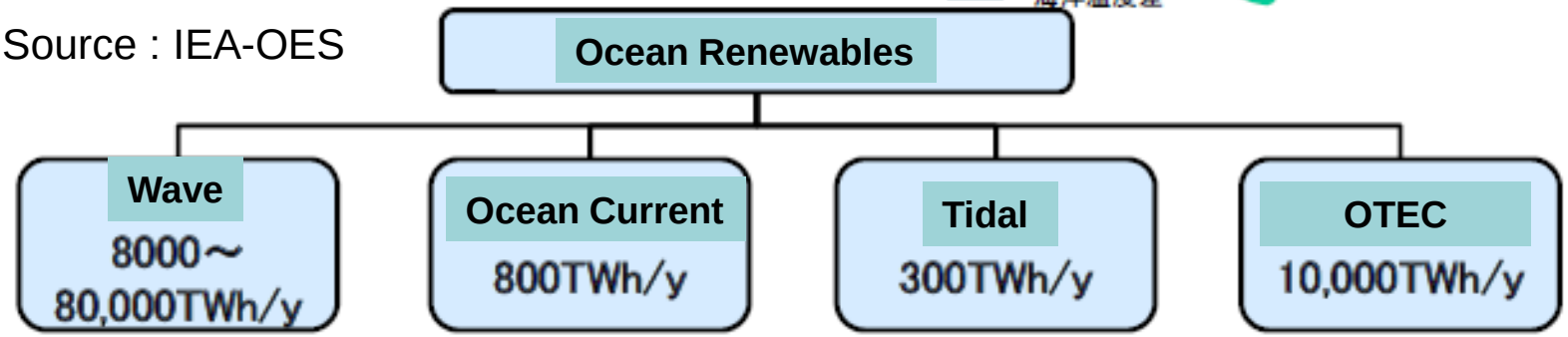


Energy Potential of Ocean Renewables

- Wave & Tidal and Ocean Current are under development.
- Some Tidal barrage projects have been commercialized.
- As far as Energy Potential, OTEC & Wave have big potential
- OTEC is under test stage



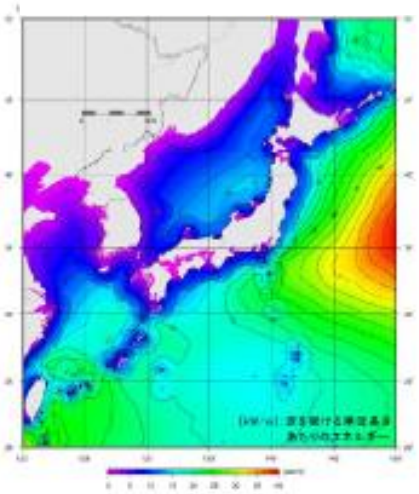
Source : IEA-OES



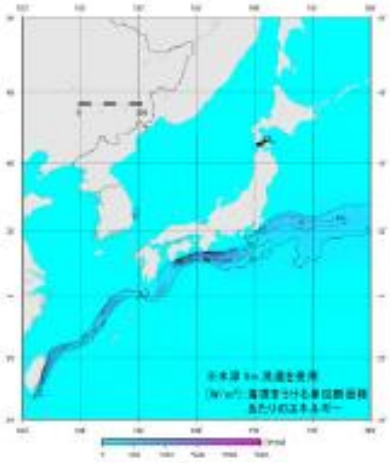
JAPAN

Energy Potential of Ocean Renewables

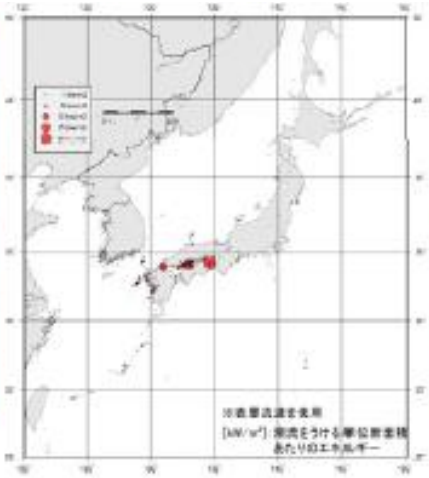
Potential map of Wave



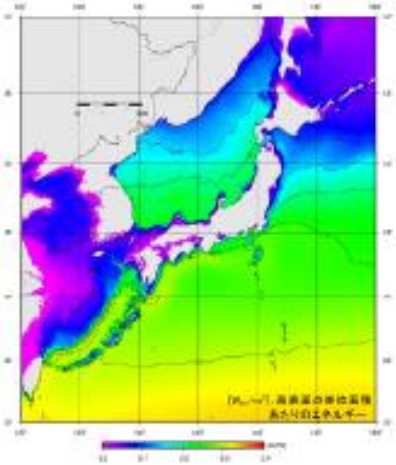
Potential map of Ocean Current



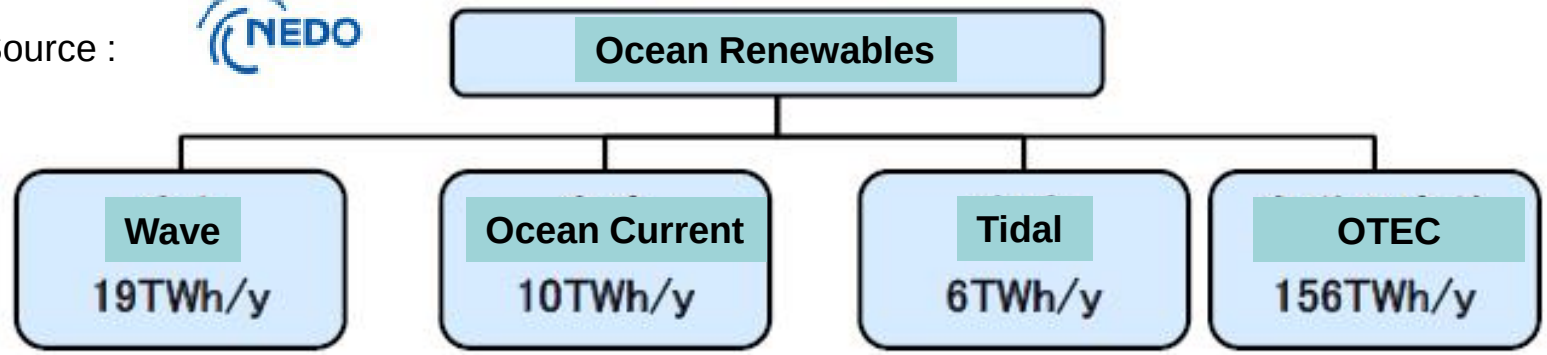
Potential map of Tidal Current



Potential map of OTEC



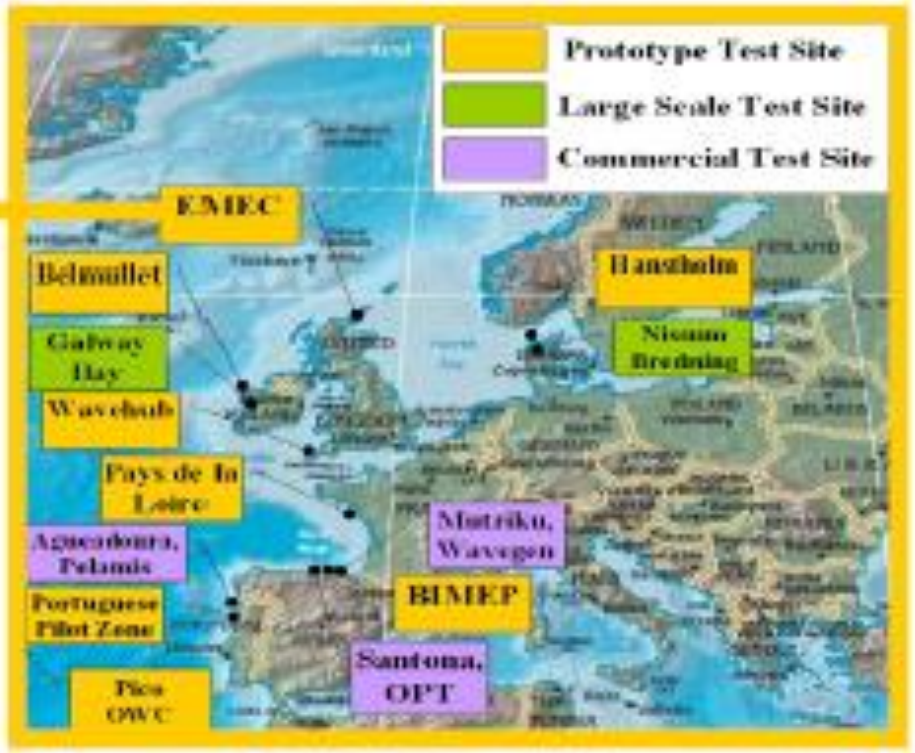
Source : NEDO

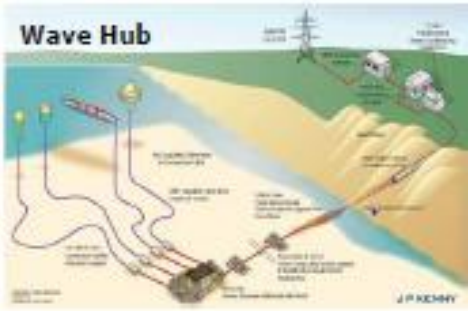


Europe

Ocean Test Sites in Europe

EMEC





Europe

EMEC test sites since 2003

European Marine Energy Centre

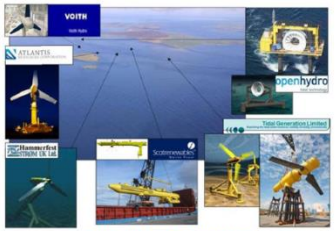


図 6-49 EMEC 潮流サイトの実証試験機

出典：EMEC 資料

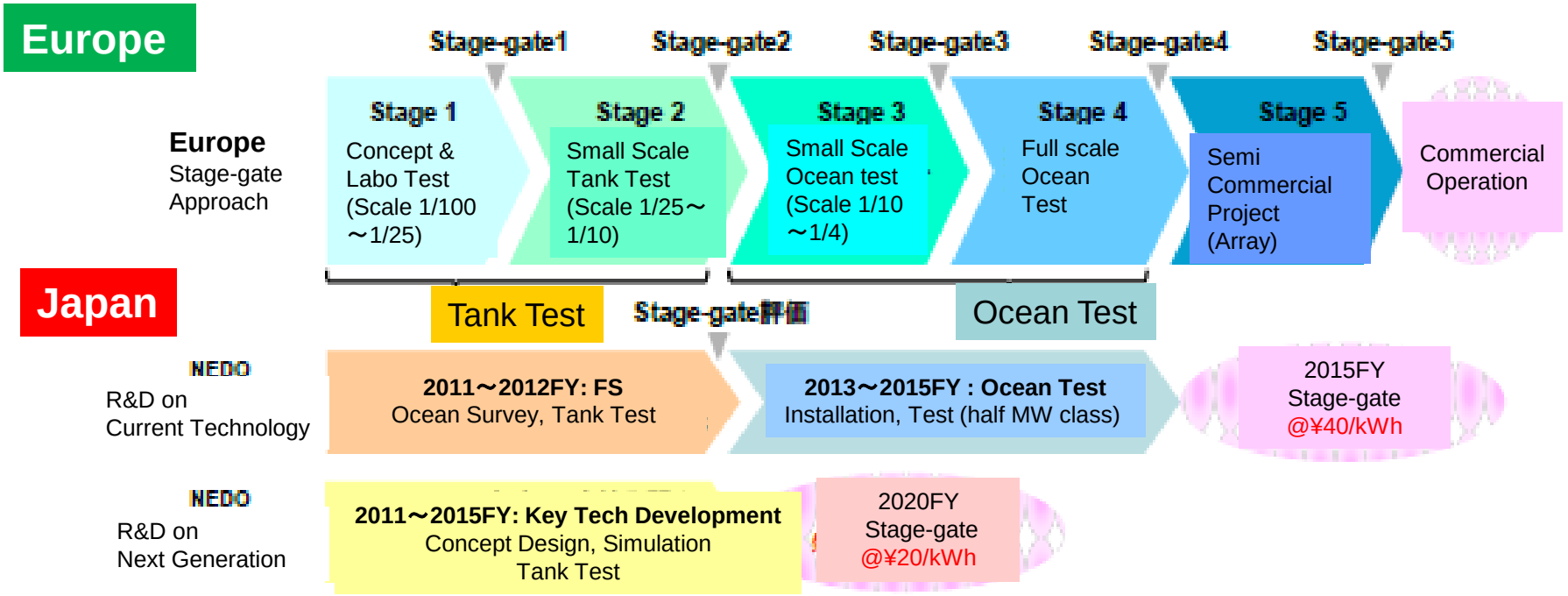
Tidal Site

図 6-48 EMEC 波力サイトの実証試験機

出典：EMEC 資料

Wave Site

R&D program by NEDO in Japan



R&D Program by NEDO in Japan

NEDO R&D Program

Current Technology

(1) On-site tests of commercial plants

- wave — Mitsui Ship Building
  point absorber, oil liquid transmission at Kozushima
- wave — MHI Bridge & Steel Str. Eng. Toa Const.
  in front of break water, OWC at Sakata
- wave — Gyro Dynamics, Hitz
  Gyroscope type at Shimizu
- Tidal current — Kawasaki H.I.
  construction & Maintenance, mooring

Hybrid of Wind & Tidal — MODEC
Vertical Axis Floating Wind with Tidal at Saga

Wave — Ichikawa Construction, Kyoritsu Electric, Idea
Overtopping Wave Converter

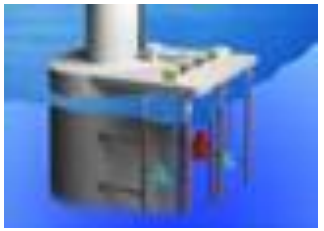
Next Generation

(2) Technologies for next generation

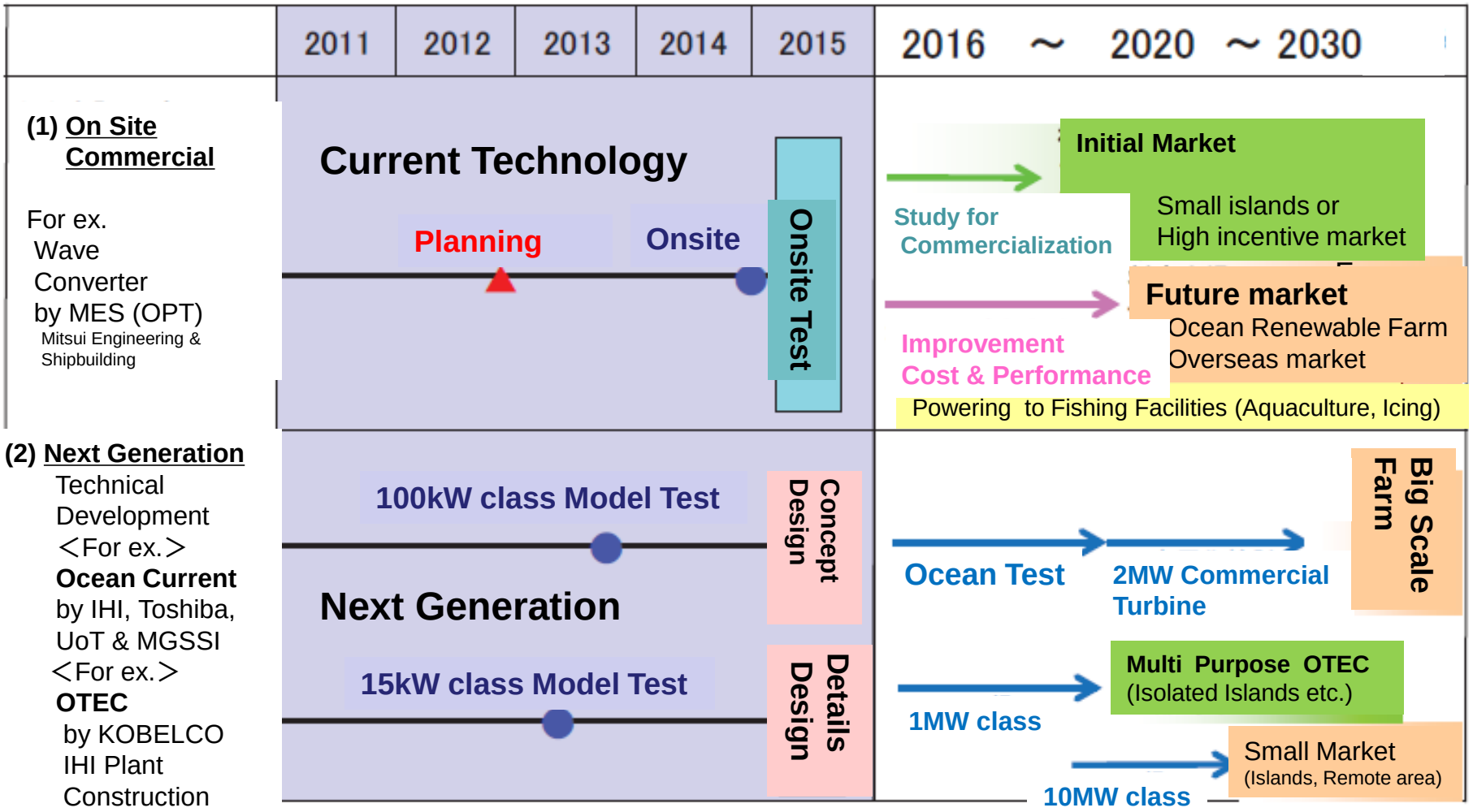
- Tidal Current — University of Tokyo, IHI, Toshiba, Mitsui Glob. Strat. S.
  Single point mooring, horizontal axis turbine
- OTEC — Saga Uni., KOBELCO
  Thermal transfer, floating riser system

Tidal — Tsuneishi Ship Building, University of Tokyo, & Kyushu University
Hydraulic Tidal Turbine

Tidal — Nakajima Propeller, Goyo Construction and Hiroshima Institute of Technology
Tidal Turbine at Foundations of Bridge



NEDO R&D & Way Forward



Public Invitation

for Local Governments by Head Quarter of Ocean Policy
(March 2013 ～ February 2014)

- Public invitation for Local Governments (Prefectures) was announced by Head Quarter of Ocean Policy (headed by Prime Minister) under the Cabinet in March 2013.
- It asked for candidates of the first ocean test sites in Japan for offshore wind and ocean renewables (FOW, and Wave, Tidal, Ocean Current and OTEC).
- Dead line for application was set at the end February 2014 (one year).
- Required conditions were shown as follows.

Ocean area: 2 km2 or larger

Term : 10 years or longer

Stake holders' consent including Fishery is required.

Natural Energy & Water Depth

FOW: exceeding 7m/sec at 80m height as monthly average (not deeper than 200m)

Wave: exceeding 1.5m wave height as monthly average (not deeper than 200m)

Tidal: exceeding 1.5m/sec as a fastest velocity speed (20m～200m)

Ocean Current: exceeding 1.0 m/sec as average velocity.

OTEC: more than 20 ℃ difference, longer than 3 months a year
(utilization of existing deep ocean water pump-up system)

Ocean Test Sites in Japan

Selection by HQOP

(7sites in 5 Prefectures, as of June 2015)

Japanese Government announced first selection of the ocean test sites in Japan for offshore wind and ocean renewables
(for the first 6sites on 15th July 2014, for Kamaishi on 22nd April 2015).

Applicant (Local Government) to the Head Quarter on Ocean Policy (Name of Prefecture)	Candidates of sites (Location Name	Type of Ocean Energy
Iwate Prefecture	Off Kamaishi city	Wave, Floating Offshore Wind
Niigata Prefecture	Off Uramura village, Awashima island	Ocean Current, (Tidal) , Wave, Offshore Wind
Wakayama Prefecture	Off Shiono-misaki cape, Kushimoto city	Ocean Current
Saga Prefecture	Off Kabeshima island, Karatsu city	Tidal, Offshore Wind
Nagasaki Prefecture	①Off Kugashima island, Goto city ②Off Kabashima island, Goto city ③Off Ejima island, Hirashima island, Saikai city	① Tidal ② Floating Offshore Wind ③ Tidal
Kagoshima Prefecture	①Nagashima Strait, Nagashima city ②Off Kuchinosima island and Nakanoshima island, Toshima village	① Tidal ② Ocean Current
Okinawa Prefecture	①Kumejima island city ②Ishigakijima island city	① OTEC ② Wave

Potential Users for Test Sites

Main Point of First Selection was whether or not there would be potential user(s).
Government (HQOP) put importance on real users of Test Sites.

Nagasaki Prefecture

Ejima Island
Hirashima Island
Tidal

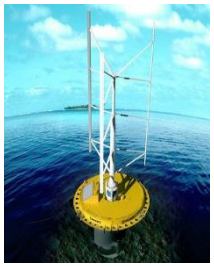
Kugashima Island
Tidal

Kawasaki

Kabashima Island
FOW

環境省 Ministry of the Environment

戸田建設 TODA CORPORATION

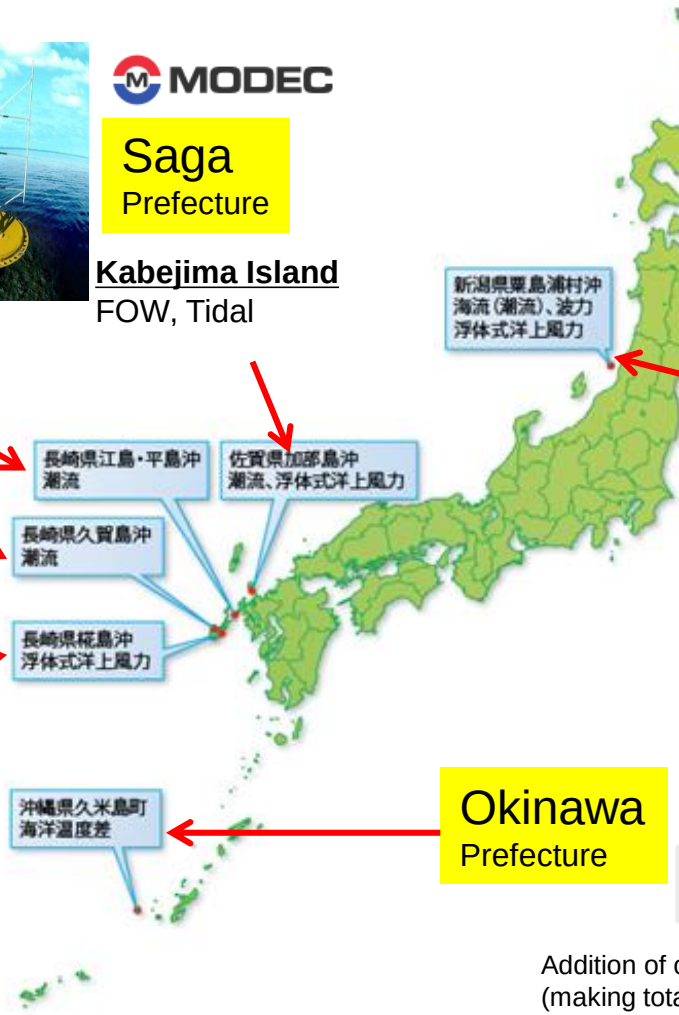


MODEC

Saga Prefecture

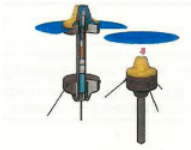
Kabejima Island
FOW, Tidal

PENSÉE OSHIMA



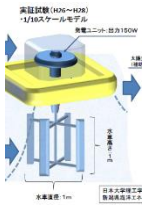
Iwate Prefecture

Kamaishi City
Wave, FOW



Univ. of Tokyo
Tohoku Univ.
Yokohama Univ.

Niigata Prefecture



Awashima Island
Wave, (Tidal),
Ocean Current
FOW

自主創造 日本大学

Nihon University

Okinawa Prefecture

Kumejima Island
OTEC

JMU Japan Marine United Corporation

Addition of one hear exchanger
(making total two)

R&D on Ocean Current

R&D Consortium (NEDO Project)

- **IHI** Floating System, Mooring System etc.
- **Toshiba** Subsea Turbine, Subsea Power Transportation
- **U o Tokyo** Simulator, Ocean Current measurement and Analysis
- **MGSSI** Pre FS, Risk Assessment

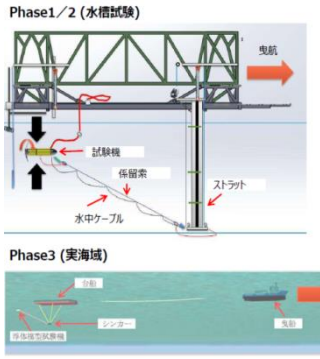
IHI Realize your dreams

東京大学 THE UNIVERSITY OF TOKYO

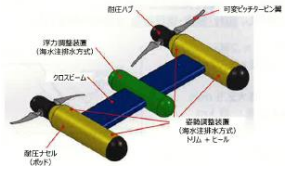
TOSHIBA Leading Innovation

MGSSI

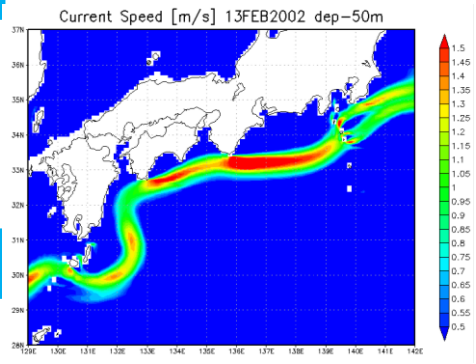
1/25 Scale Model (November 2011 ～ March 2015)



1/3 Scale Model 200kW (100kW x 2) (Dec 2014 ～ March 2018)

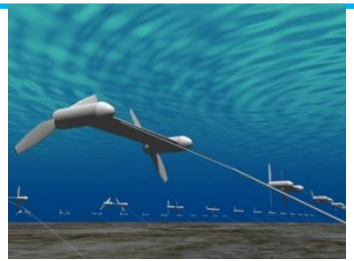


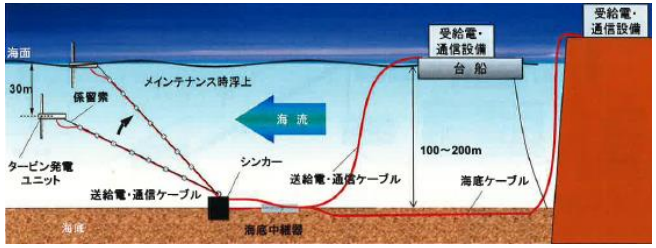
OW: 33m, OL 15m
RD : 12m
WT : 200 Tons
200kW at 1.5 m/Sec



Ocean Current Map of KUROSHIO

Full Scale in Future 2MW per Unit (1MW x 2)

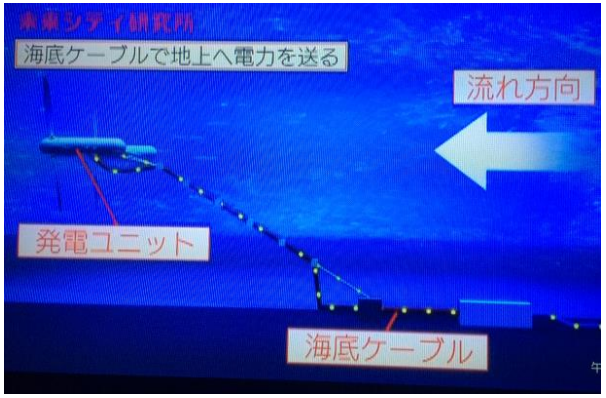


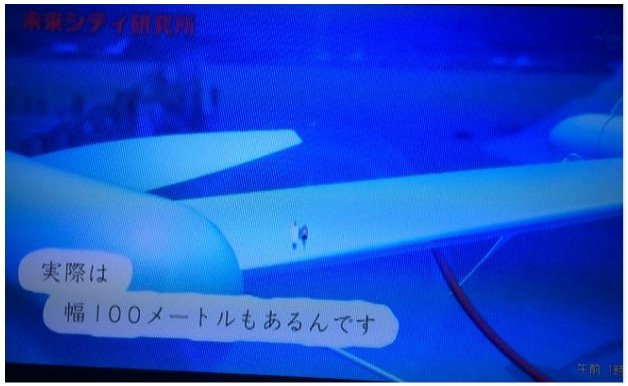


From TV Program in Japan

(1) Program : TV Tokyo「Future City Laboratory #29」
(2) Date on TV : 22:54～23:00 27th April 2015
(3) Theme : Ocean Current Generation (IHI, Toshiba, UoT, MGSSI)

http://www.tv-tokyo.co.jp/miraicity/backnumber/029.html (2:57)





Thank you for your attention !

Mitsui Global Strategic Studies Institute

Yo.Oda@mitsui.com