Status and Perspectives of the Utilization of Marine Renewable Energy in Japan

Tokio Wada and Ken Takagi

Department of Research Management, Fisheries Research Agency
Department of Ocean Technology, Policy, and Environment,
Graduate School of Frontier Sciences, The University of Tokyo

The Bill of the Basic Act on Global Warming Countermeasures

(Cabinet approved in Oct. 8, 2010)

Mid-term Goals:

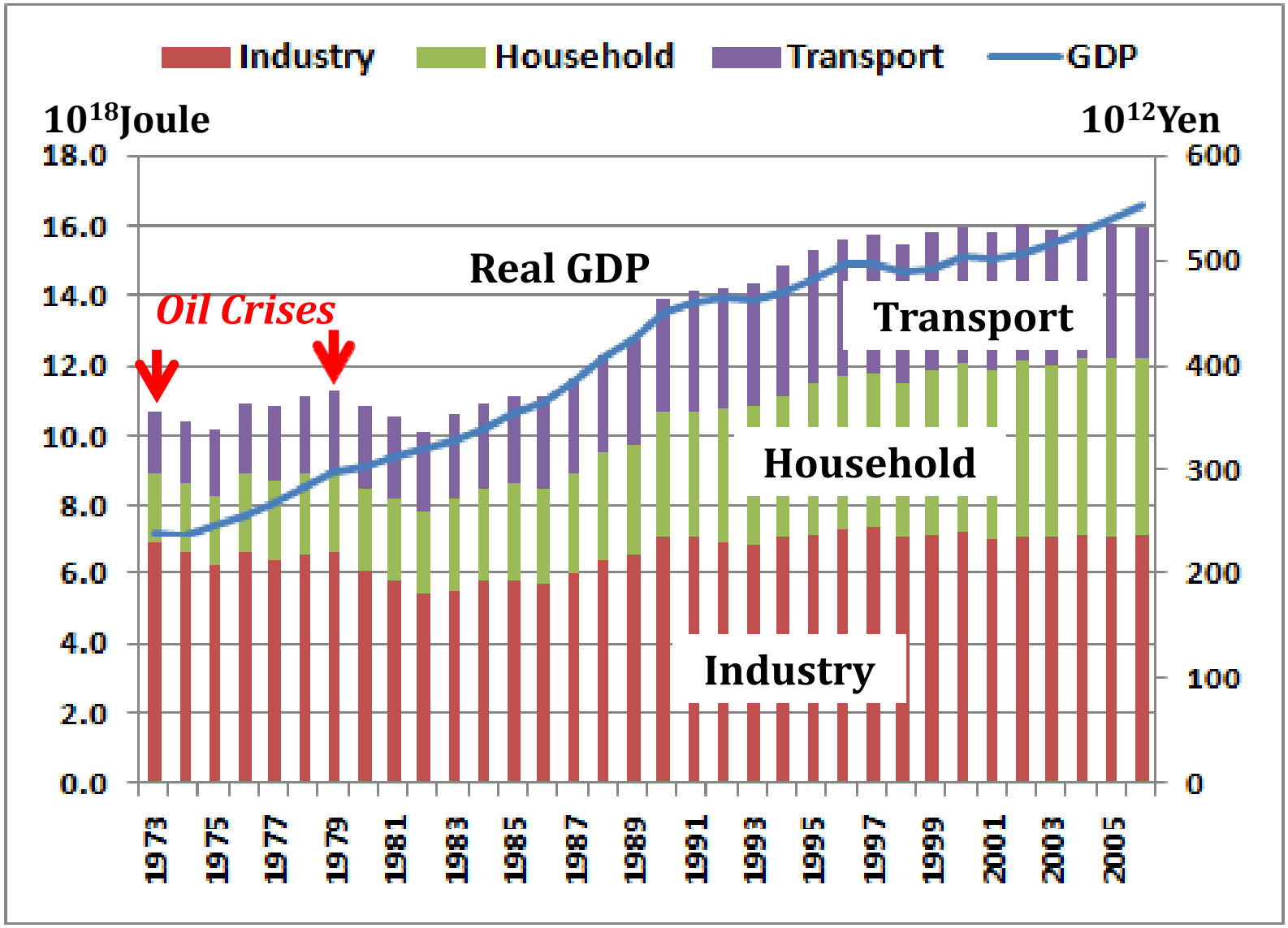
- A reduction of 25% in greenhouse gas emissions below the 1990 level by 2020.
- Increasing the share of renewable energy to 10% of the total primary energy supply by 2020.

Promoting "Ocean Renewable Energy" use

Topics: **Current status of R&D/Problems/ Perspectives of the practical use**

Demand and Supply of Energy in Japan

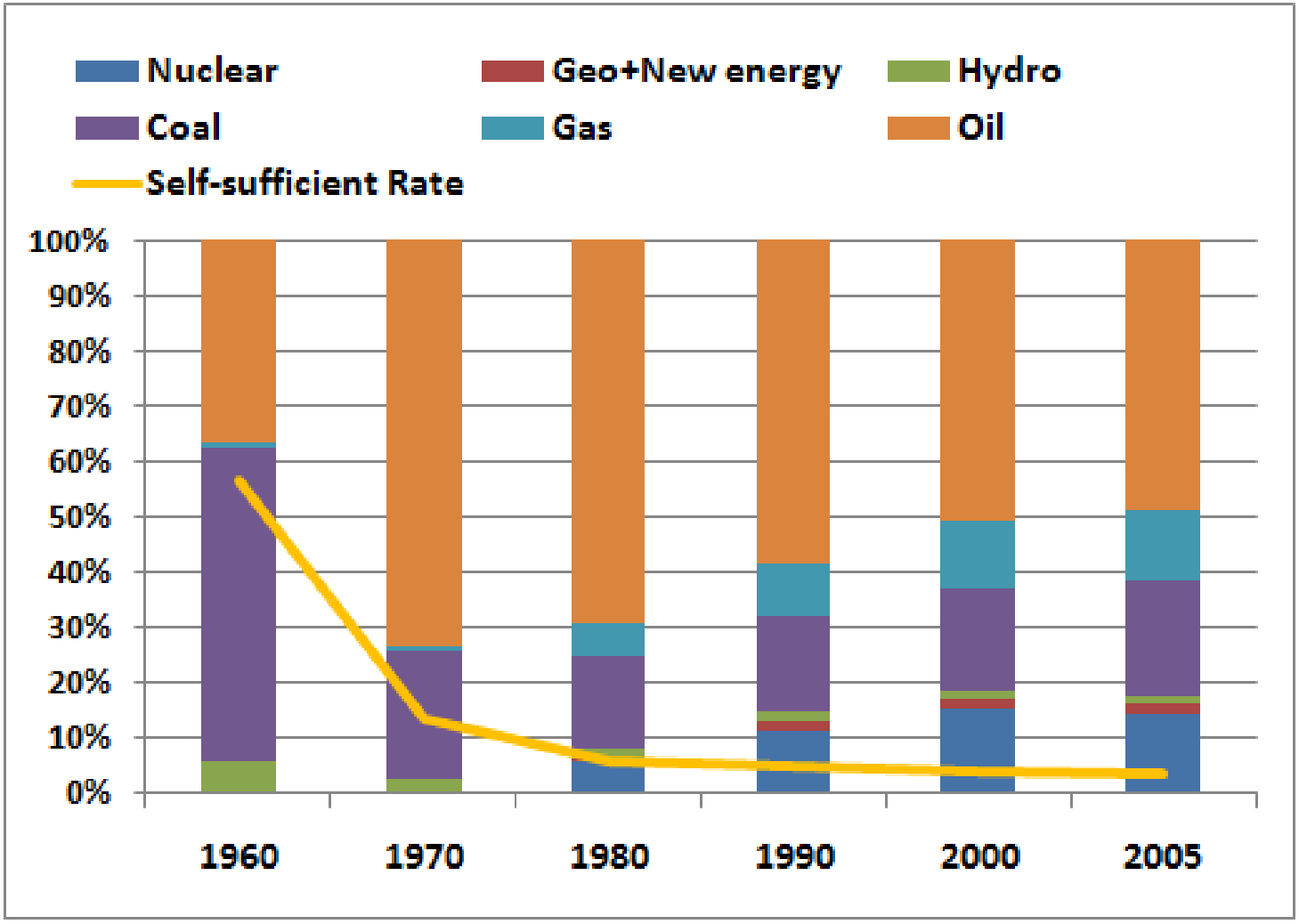
1. Final Energy Consumption



(Source: Agency for Natural Resources and Energy "Comprehensive Energy Statistics")

Demand and Supply of Energy in Japan

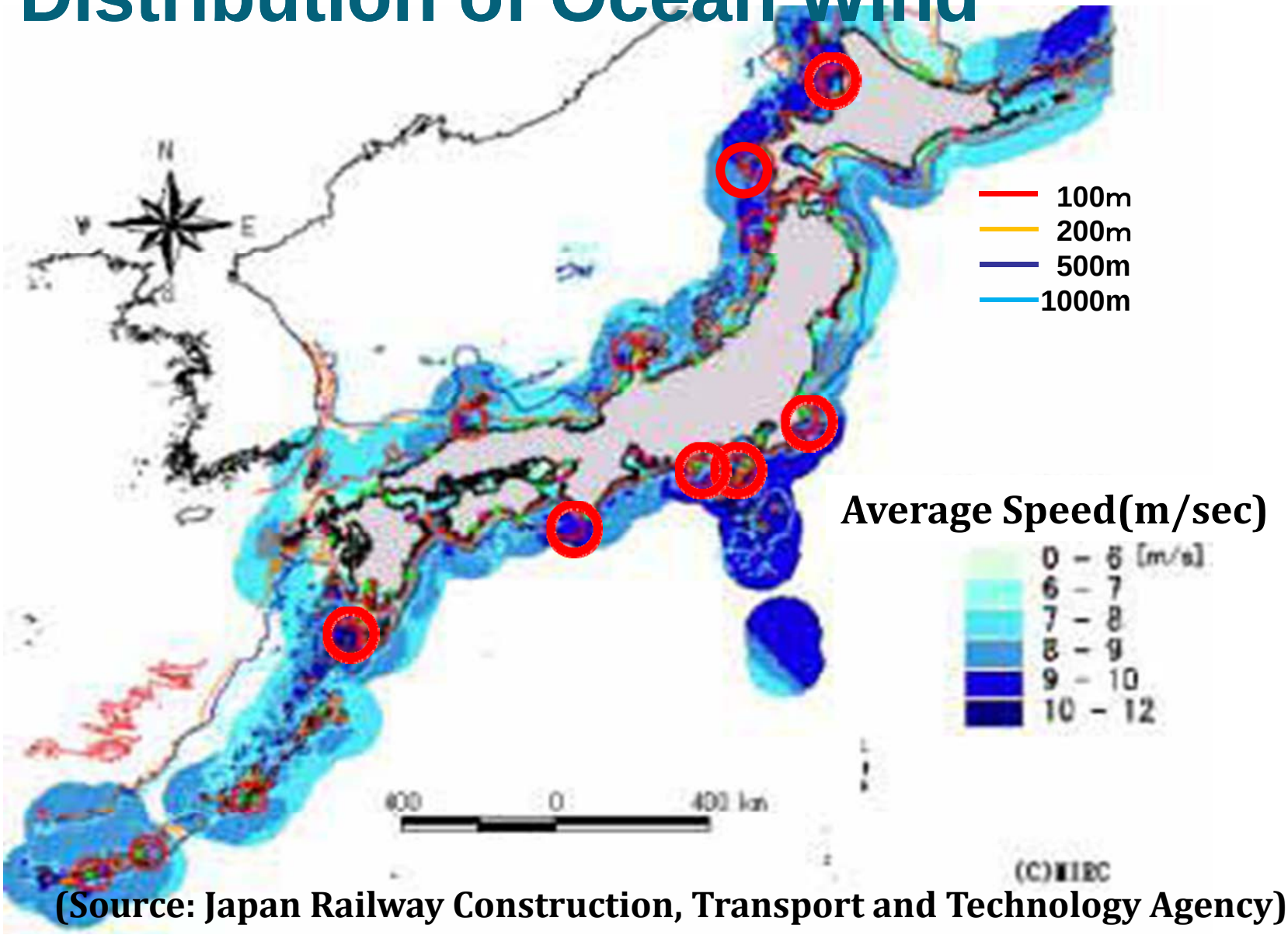
2. Energy sources and Self-sufficiency ratio



(Source: Agency for Natural Resources and Energy "Comprehensive Energy Statistics")

Potential of ORE in Japan

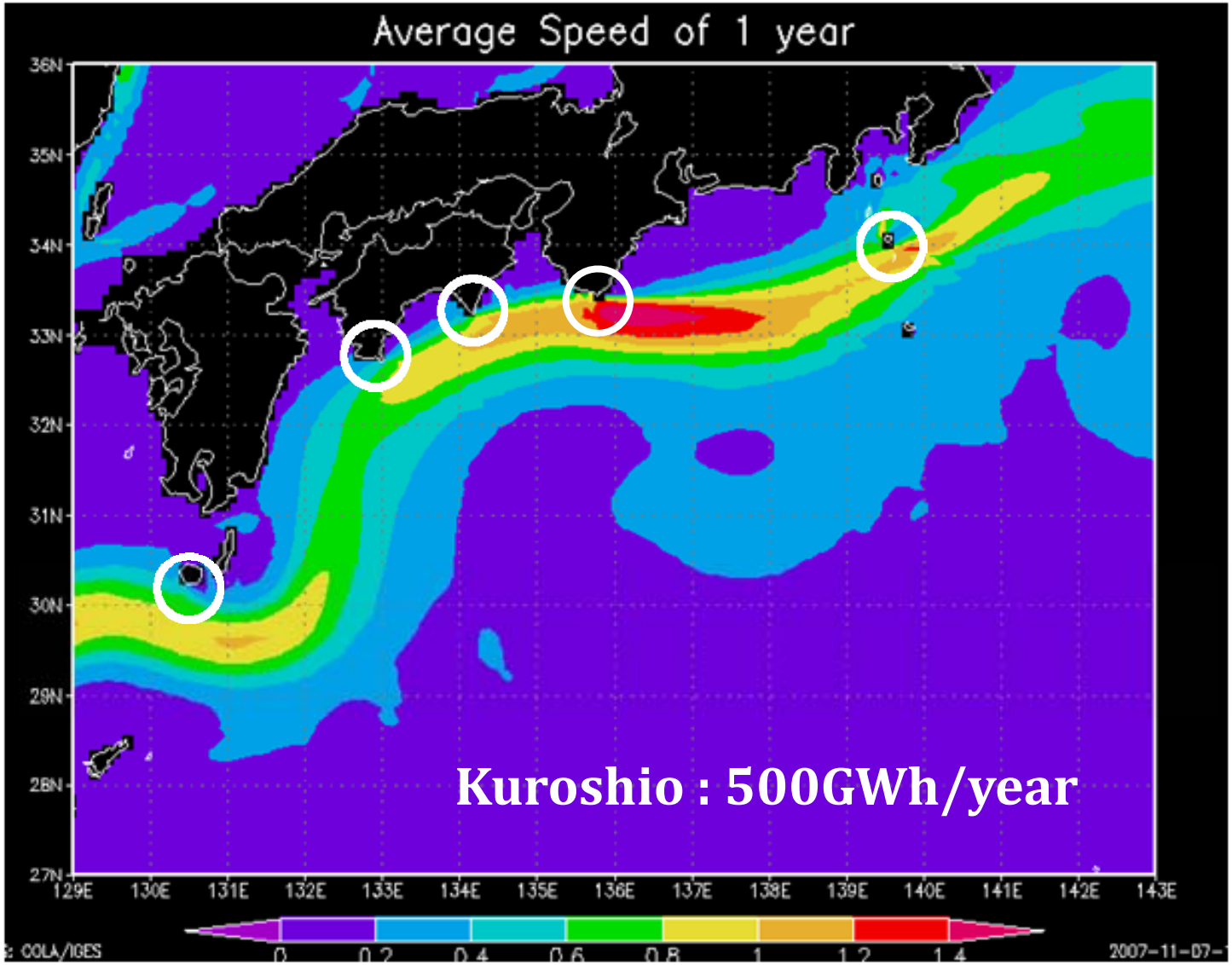
1. Distribution of Ocean Wind



(Source: Japan Railway Construction, Transport and Technology Agency)

Potential of ORE in Japan

2. Distribution of Ocean Current



(Source: Suzuki et. Al., 2008)

Potential of ORE in Japan

3. Electricity efficiency and Area required for Generating the total Electricity of Japan

Type of Energy /Technology	Electricity (kWh/m^2)	Area required (km^2)	Percentage of EEZ ≦1000m
Offshore wind	41	25,100	3.1
Wave	8.5	121,000	15.1
Ocean Current	51	20,200	2.5
Solar PV	140	7,360	0.9

- Total Electricity Demands in 2008: 1.03 TWh
- Area of EEZ shallower than 1,000m depth: 803,000km^2

Potential of ORE in Japan

4. Economics of Power Generation from ORE

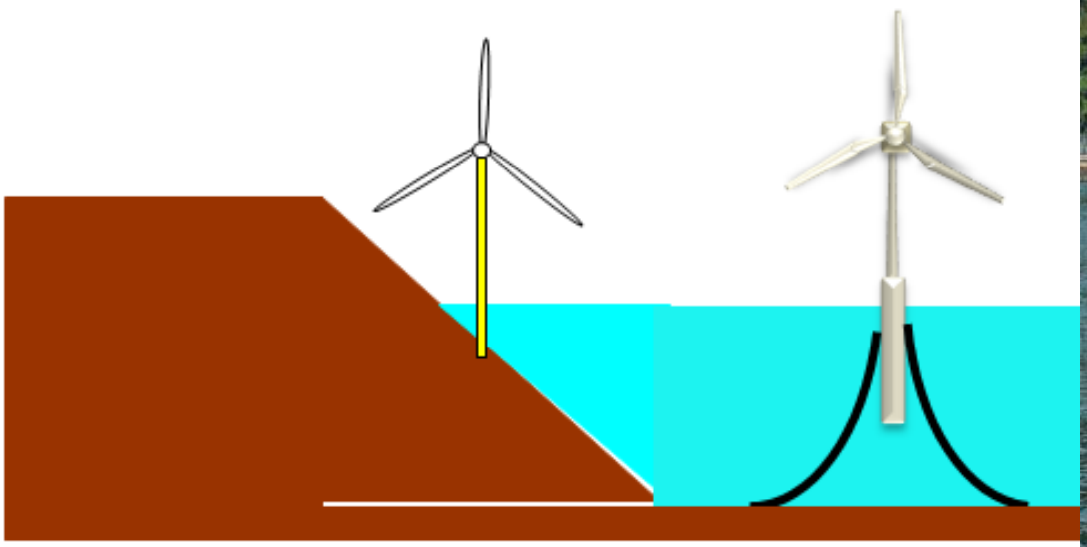
Type of Energy /Technology	Facility Cost (¥/kW)	Capacity Factor(%)	Power Price (¥/kWh)
Offshore wind	300,000	40	9～14
Wave	400,000	10～30	10～30
Ocean Current	400,000	40～70	7～14
Onshore wind	250,000	30	9～14
Solar PV	300,000	10	50
Nuclear	700,000	80	6

(Source: Suzuki, 2009)

Current Status of R&D and Practical Use

1. Offshore Wind

- **Most promising type of energy source**
  Electricity target: 11MW → 1GW by 2020
- **R&D : Floating wind turbine**
  ← *Larger depth of ocean around Japan*



Experiment with 1/10 scale Model of Spar-type offshore wind turbine by Kyoto Univ.

(左・右上)京都大学チームによる洋上風力発電1/10モデル実験、長崎県佐世保の海上にて
(右下)洋上での風況測定調査・観測機器、長崎市池島町

Current Status of R&D and Practical Use

2. Ocean Current and Tidal Stream

- **Location:** ***Straits and Isolated Islands***
- **Size of Facility:** ***Small*** **～** ***Medium*** **(1～2MW)**
- **R＆D:** ***A proposal of experimental plant for Miyake-jima***

3.Ocean Wave

- **R&D:** ***Various accumulation of studies on Oscillating Water Column type, but Studies are behind in Moving body type***

  (ex. Pelamis Wave Power Convertor, UK)

Problems

1. Accumulation of Fine-scale Oceanographic Data

- Oceanographic data at 1 km mesh scale is requested to determine the type and size of a power generator.

2. Cooperation with Fisheries and Other Industries

- Developing win-win relationships with fisheries and other industries is essential for introducing power generation systems using ocean renewable energy.

3. Development of a System for Verification tests

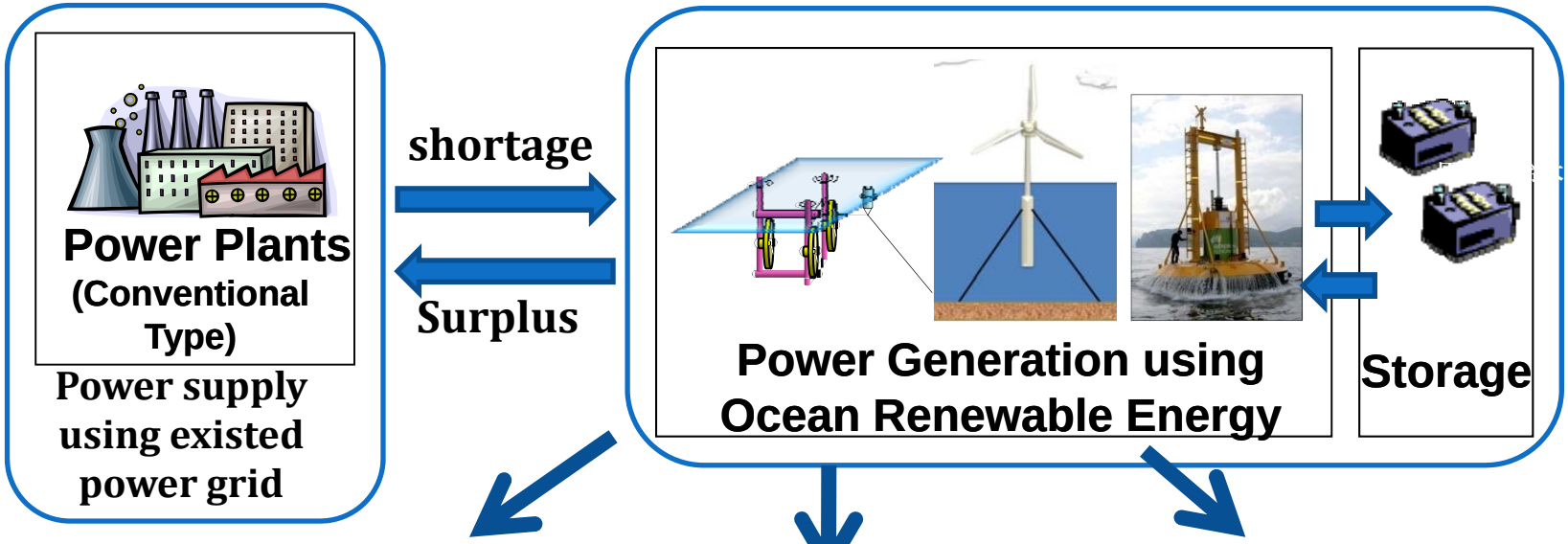
- Areas reserved for the verification of devices should be prepared by the government for promoting the R&D and practical use of ocean renewable energy.

4. Harmony with the Environment

- Assessment and mitigation of physical effects of a facility on the ecosystem and organisms around it are essential for the sustainable use of ocean renewable energy.

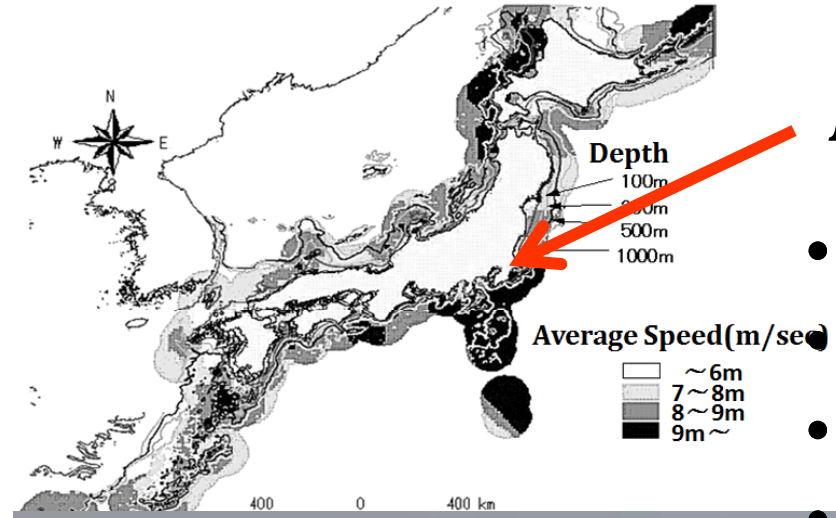
Perspective: A Closed system of ORE

Power Generation for Fishing Industry



A Local Production for Local Consumption System in Energy

An Example of Wind Power Generation for the Facilities of Fishing Port



Hasaki fishing port

- **Nominal output: 1MW**
- **Total Electricity: 2,702MWh**
- **Capacity Factor: 30.8%**
- **Aveg. Wind Speed: 6.45m/sec.**

(track record in 2005)

Reductions of 47.7% in power consumption by the ice plant, and 1,080ton of CO_2 emission.

Summary

- To reduce CO2 emission, we must promote the utilization of ocean renewable energy.
- Enough ocean renewable energy is distributed in Japanese EEZ, and profitable economically.
- Some progress has been made on offshore wind, but behind in other energy source.
- For the verification tests in commercial scale, the Government should provide the test field.
- As a practical approach, we propose a closed system of ocean energy power generation for the fishery in a coastal area or remote island.