Energy Policy Agenda after the Great East Japan Earthquake

June 3, 2011 (Friday)

The Institute of Energy Economics, Japan

Chairman & CEO Masakazu Toyoda

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1. Short-Term Agenda

(1) Response to the NPP Accident ①

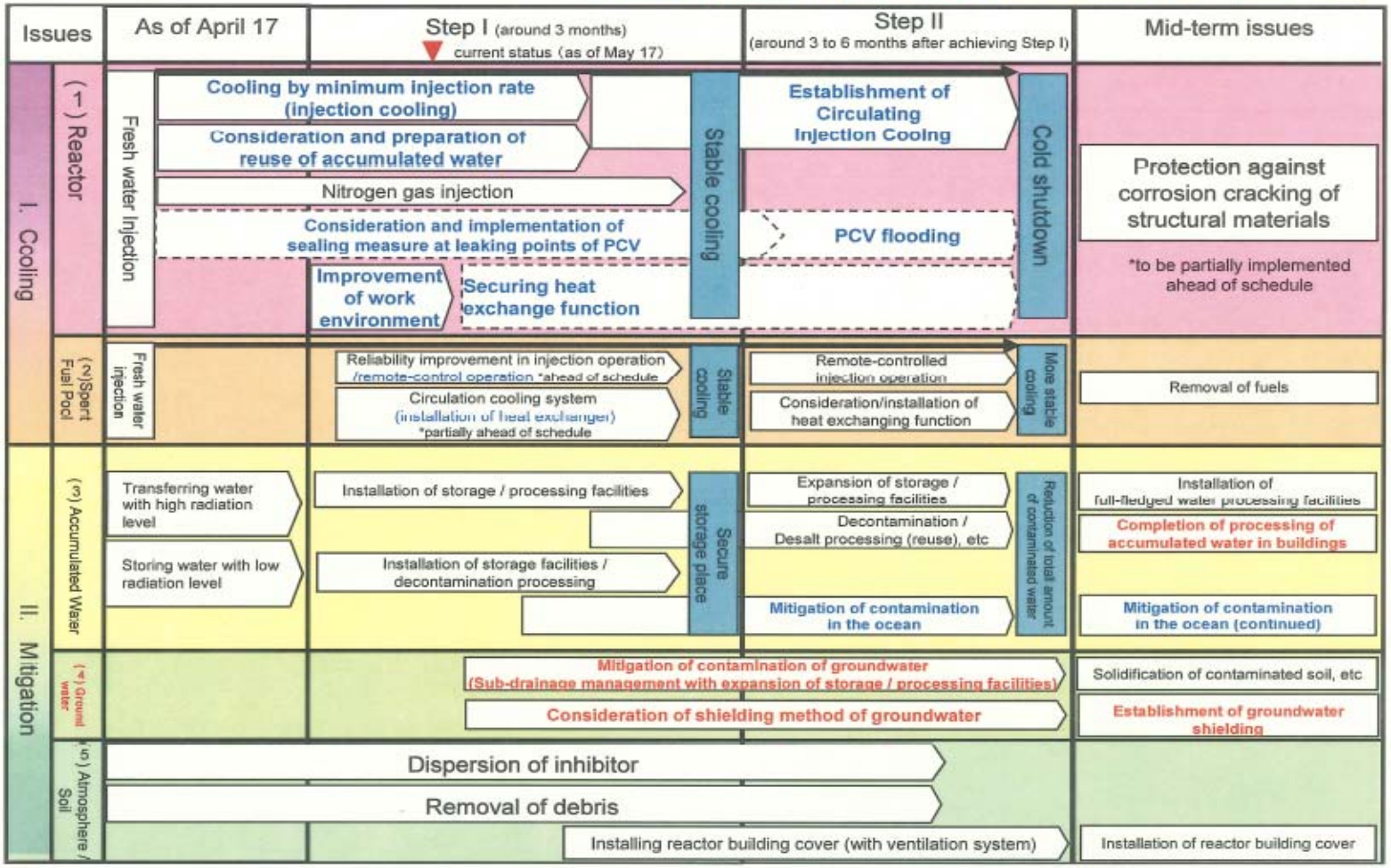
1) Stabilization of Fukushima Daiichi NPP

- Installed capacity of Fukushima Daiichi is 4,696MW, while that of Fukushima Daini is 4,400MW.
- As of April 2011, there are 54 nuclear reactors in Japan: 19 in operation and 35 either under periodic inspection or shutdown, and another 2 under construction. Total installed capacity is 48,960MW. Nuclear energy accounts for 25% on an installed capacity basis and 30% on a power generation basis in fiscal year 2007.
- For the time being, TEPCO will steadily carry out the revised 2 step roadmap for stabilization. At other NPPs, utmost efforts are being made to ensure safety focusing on measures against tsunami based on the Urgent Safety Measures. Operation of Hamaoka NPP (2,617MW) was suspended in response to the Prime Minister's request on May 7.
- Unless the reactors resume operation after planned outages, there will be serious energy shortages throughout Japan. Thus, steady restoration of NPPs is essential.

1. Short-Term Agenda
(1) Response to the NPP Accident ②

Fig.1 Current Status of Roadmap (issues/targets/major countermeasures) as of May 17

Red colored: newly added to the previous version, Blue colored: modified from the previous version



From the information provided by TEPCO

1. Short-Term Agenda
(1) Response to the NPP Accident ③

2) Response to compensation issues

- Amount of compensation is estimated to reach ¥3 – 5 trillion.
- Size and scheme of compensation are under review by the committee.
  An expeditious response is required based on the Act on Compensation for Nuclear Damages.

3) Response to harmful rumors

- Import restrictions on Japanese products (agricultural, fishery and industrial products), and drastic decline of foreign tourists to Japan
- At least the following 4 responses are necessary:
  a. Provision of detailed information
  b. Issuance of product safety certificates by the Japanese Government, etc. ,whenever necessary
  c. Explanation of the current situation by the Japanese Government
  d. Giving publicity the safety of Japan by visiting foreigners

1. Short-Term Agenda

(2) Response to the Electricity Shortage ①

◆ Outlook for electricity supply this summer

TEPCO will maximize the interchange of electricity with Tohoku Electric. As a result, TEPCO's supply capacity is projected to be 53,800MW (end of July) while that of Tohoku Electric is expected to be 13,700MW (end of August). Thus, the required minimum reductions in demand are 10.3% for TEPCO and 7.4% for Tohoku Electric.

	Tohoku Electric		TEPCO	
	End of July	End of August	End of July	End of August
Forecasts for electricity supply	12,800MW	12,300MW	55,200MW	56,200MW
Amount of electricity interchange	+1,400MW	+1,400MW	▲1,400MW	▲1,400MW
Electricity supply after interchange	14,200MW	13,700MW	53,800MW	54,800MW
Demand projection	14,800MW	14,800MW	60,000MW	60,000MW
Required minimum reduction in demand	4.1%	7.4%	10.3%	8.7%

1. Short-Term Agenda
(2) Response to the Electricity Shortage ②

◆ Target reduction in demand: 15% in all areas covered by TEPCO and Tohoku Electric

(1) Large lot customers (business operators whose contract demand is 5,000MW or more)

— 637 companies are participating in the voluntary action plan led by the Japan Federation of Economic Organization (end of April)

(2) Small-scale customers (business operators whose contract demand is less than 5,000MW)

— Establishment of voluntary restraint programs

— Announcement of "Standard Format for Energy Conservation Action Plan"

(3) Household customers

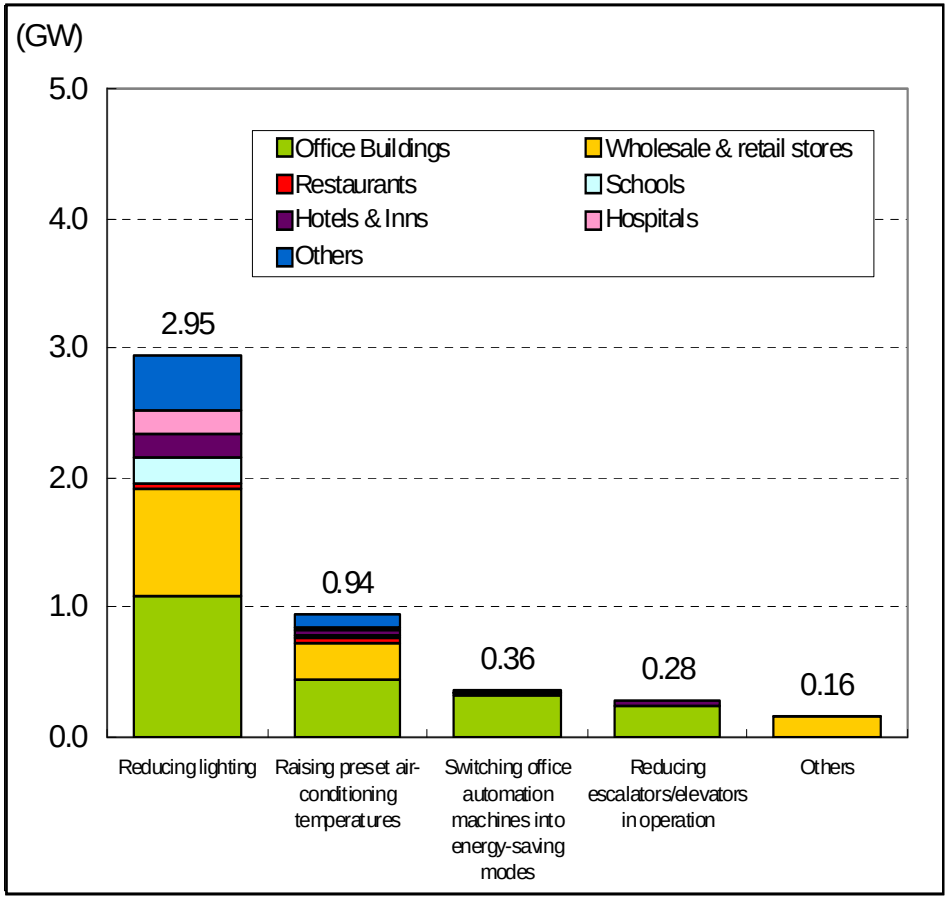
— Announcement and promotion of "Measures for Energy Conservation in Households"

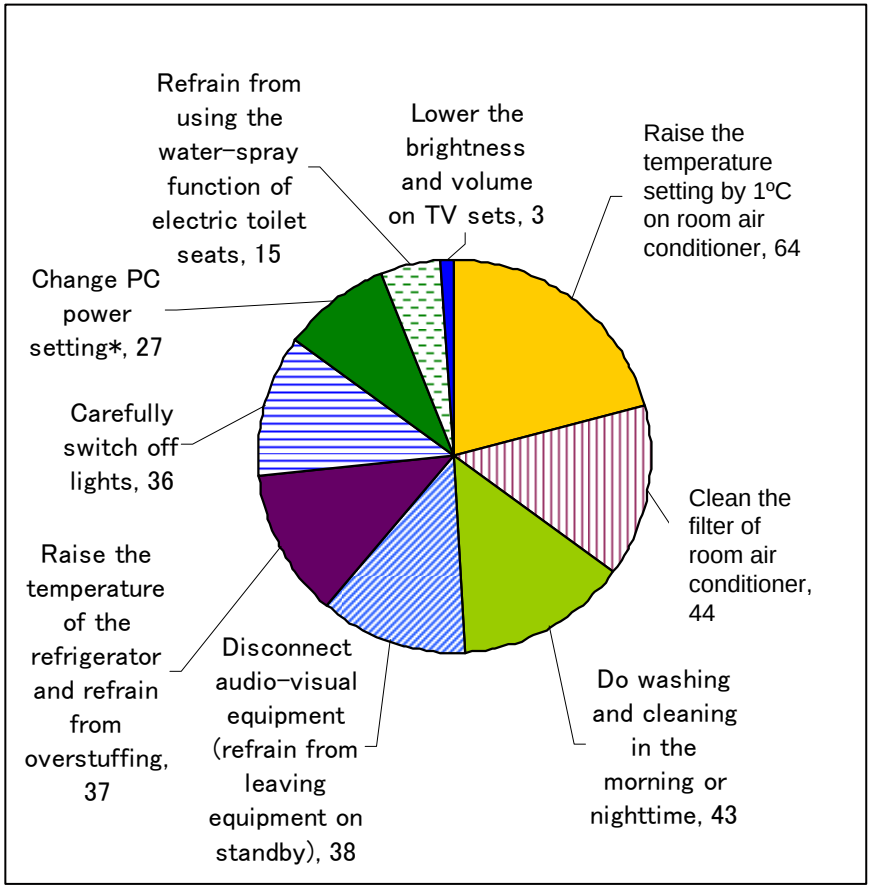
Note: Establishment of energy conservation programs by the national government, incorporated administrative agencies and public interest corporations

1. Short-Term Agenda
(2) Response to the Electricity Shortage ③

◆ Energy conservation by industry and households

Power saving by energy conservation measures taken by office and commercial buildings in TEPCO's area (estimated maximum: 4,000MW)





Both figures are based on estimations by the IEE.

1. Short-Term Agenda

(3) Measures for demand/supply balance of oil and gas ①

◆ **Impact on worldwide demand/supply of oil and gas**

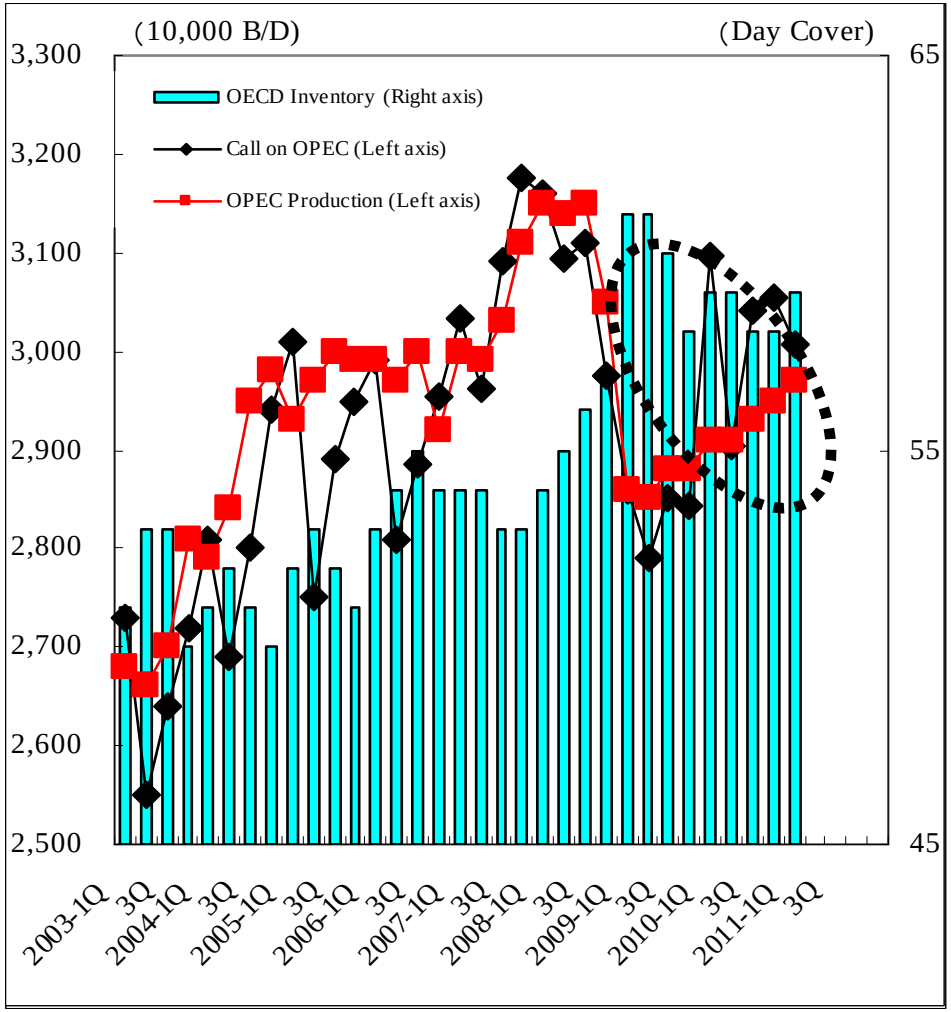
- **Reducing factors**
  - ◇ Reduction of demand due to slowing down of economic growth, general decline in industrial activity
- **Growth factors (expected to have a larger impact)**
  - ◇ Additional operations of oil- and gas-fired thermal power plants by TEPCO and Tohoku Electric
  - ◇ Additional demand by other electric power companies
    - ○ Possibility of delay in restarting units after periodic inspection
    - ○ Increase of in-house power generation
  - ◇ Amount of increase consists of 120-150 thousand B/D of oil and 9.9-12.2 million tons of LNG.
- **Supply of both oil and LNG seems to be assured as a whole.**
  - ◇ Extra supply is available on international markets.
  - ◇ Can use various procurement channels.
  - ◇ However, there are some restraints on supply/demand (especially LNG).

1. Short-Term Agenda

(3) Measures for demand/supply balance of oil and gas ②

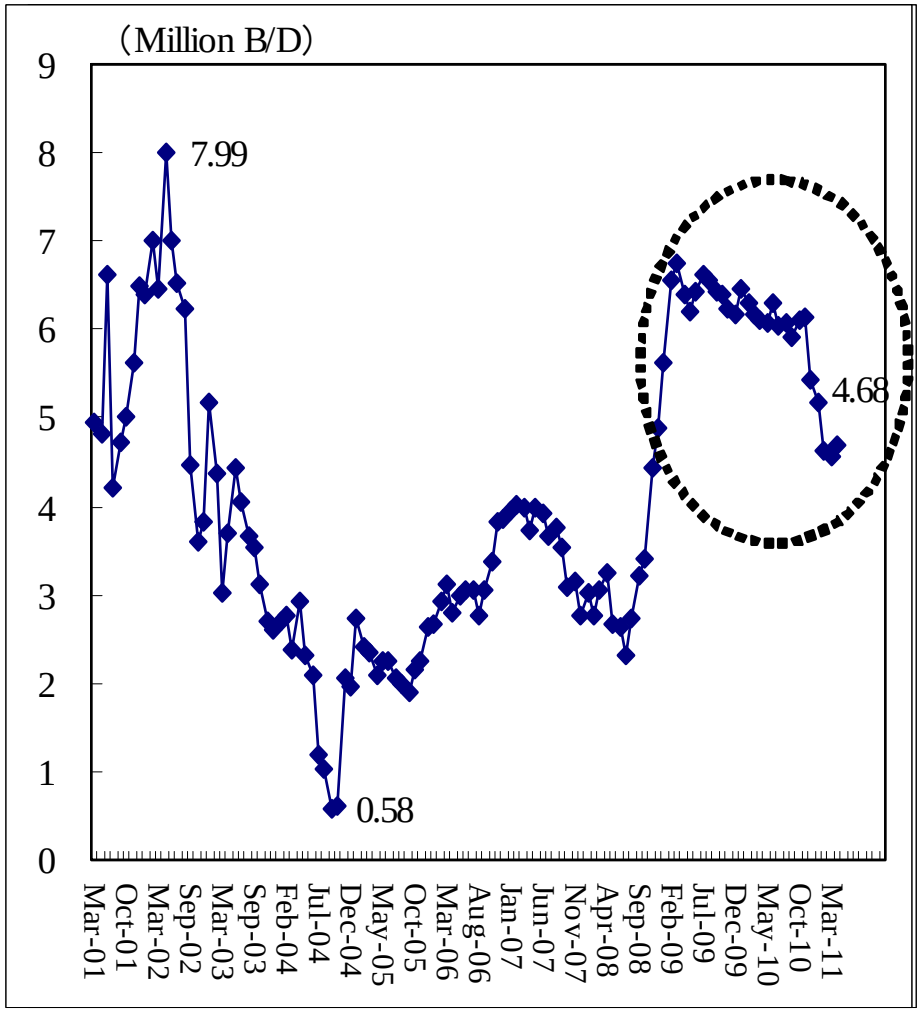
◆ Energy-sector fundamentals

OPEC Production and OECD Inventories



OECD inventory day cover is 59 days at the 2011 1Q

OPEC Surplus Production Capacity



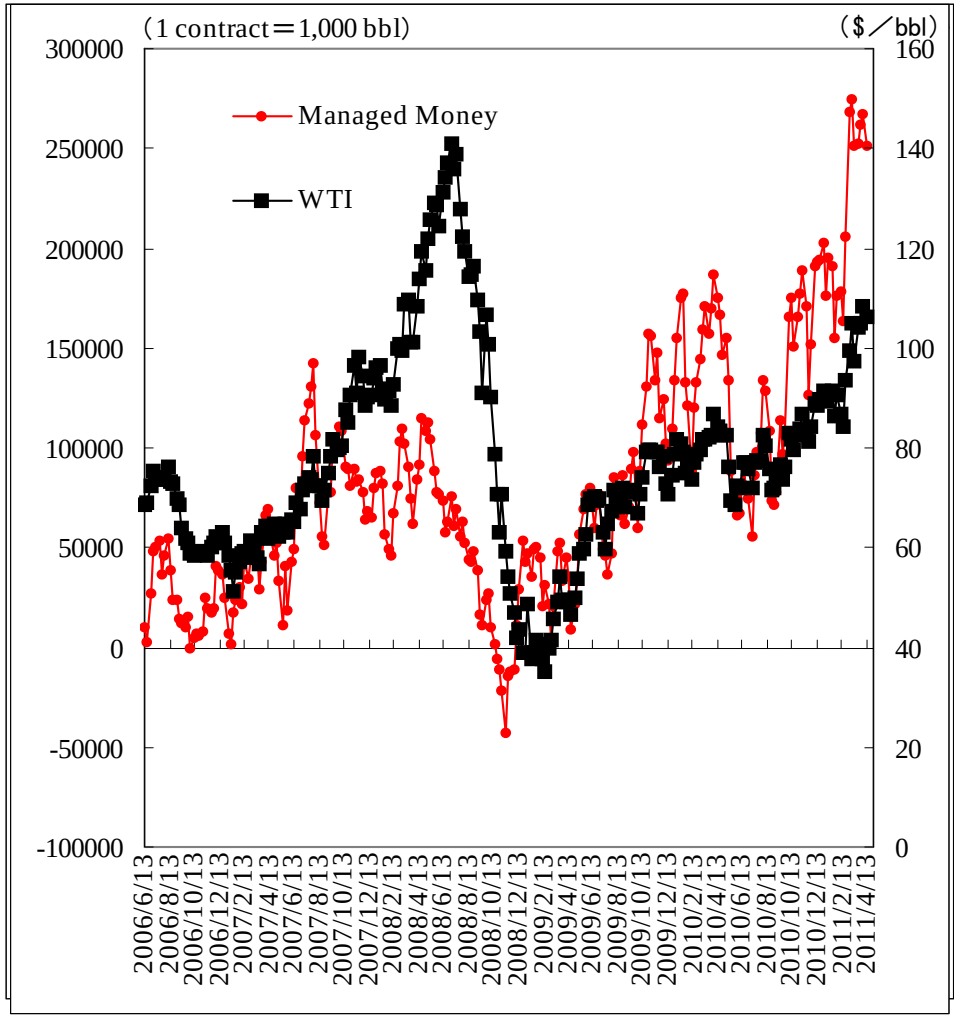
Source: Prepared from IEA “Oil Market Report”

1. Short-Term Agenda

(3) Measures for demand/supply balance of oil and gas ③

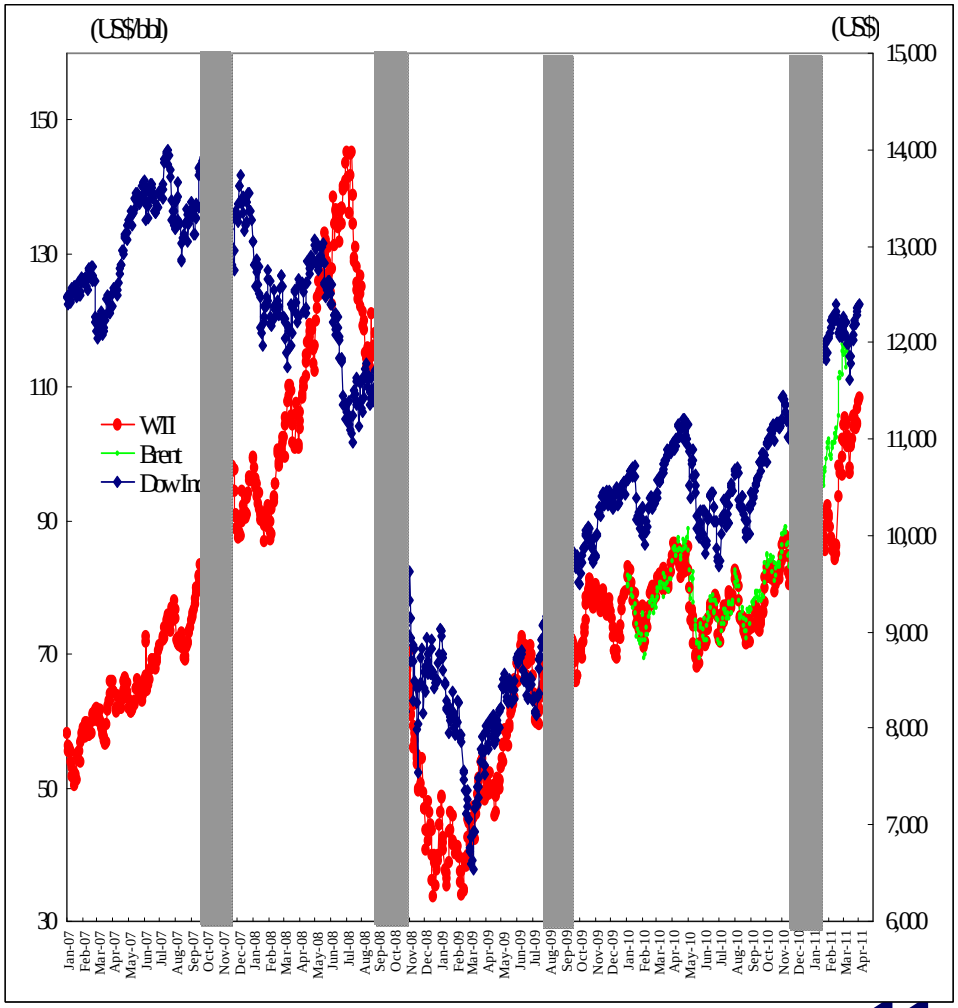
◆ Speculative aspects

"Managed Money" and WTI prices



Prepared based on NYMEX and US CFTC information

WTI (Brent) and NY stock price



Prepared based on NYMEX information

2. Medium- to Long-Term Agenda

○ Review of the Basic Energy Plan ①

(1) Current Basic Energy Plan (2009-2030)

- Double the self-sufficiency of energy supply and independent development rate of fossil fuel.
  Increase the self-sufficiency rate of energy supply* from 38% to 70%.
  *Take into consideration the independent development of resources in addition to the conventional self-sufficiency of energy supply (domestically produced energy + nuclear energy).
- Raise the rate of zero-emission power sources from 34% to 70%.
- Decrease CO2 emissions from "daily life" (residential sector) by half.
- Maintain and enhance the world's highest energy efficiency in the industrial sector.
- A group of Japanese companies to achieve top share in the international energy products market.

↓

① Assure energy security to protect the Japanese people.
② Achieve low-carbon type economic growth, which can be a model for the world.
③ Reform "daily life" that Japanese people can be aware of.
④ Contribute to global CO2 emissions reductions and attract foreign investment to Japan.

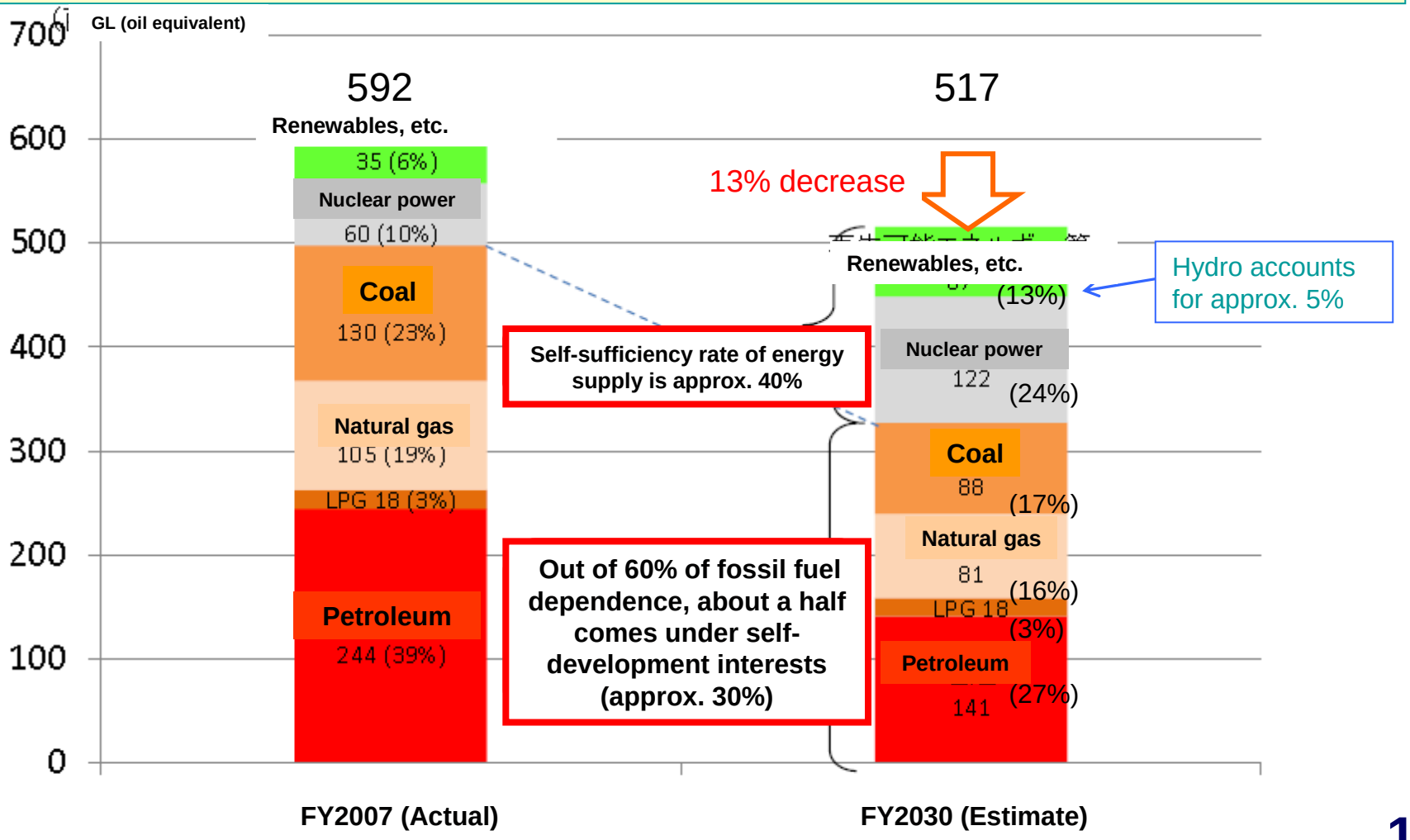
↓

- Decrease CO2 emissions from energy production by at least 30% by 2030 compared with 1990, by thoroughly promoting the policies of this plan.
- This is a very ambitious goal, corresponding to approximately half of the CO2 emissions reduction target of 80% by 2050 from the 1990 level.

Reference: Basic Energy Plan: Energy Composition

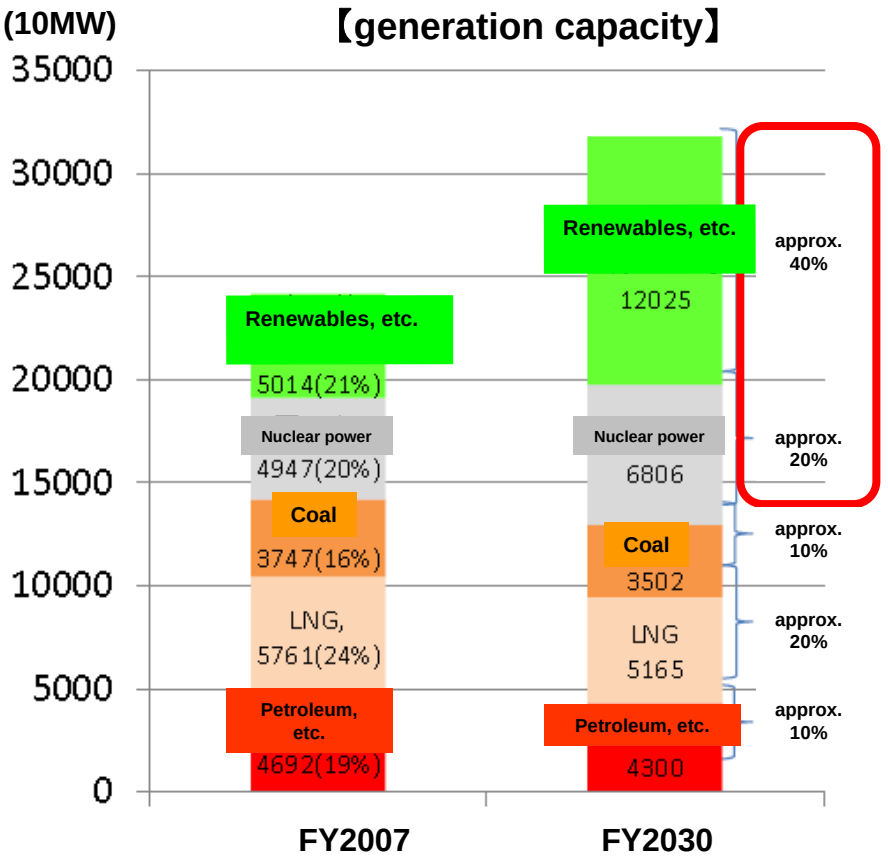
○ **Raise self-sufficiency of energy supply (self-sufficiency + independent development) from 38% to 70%.**

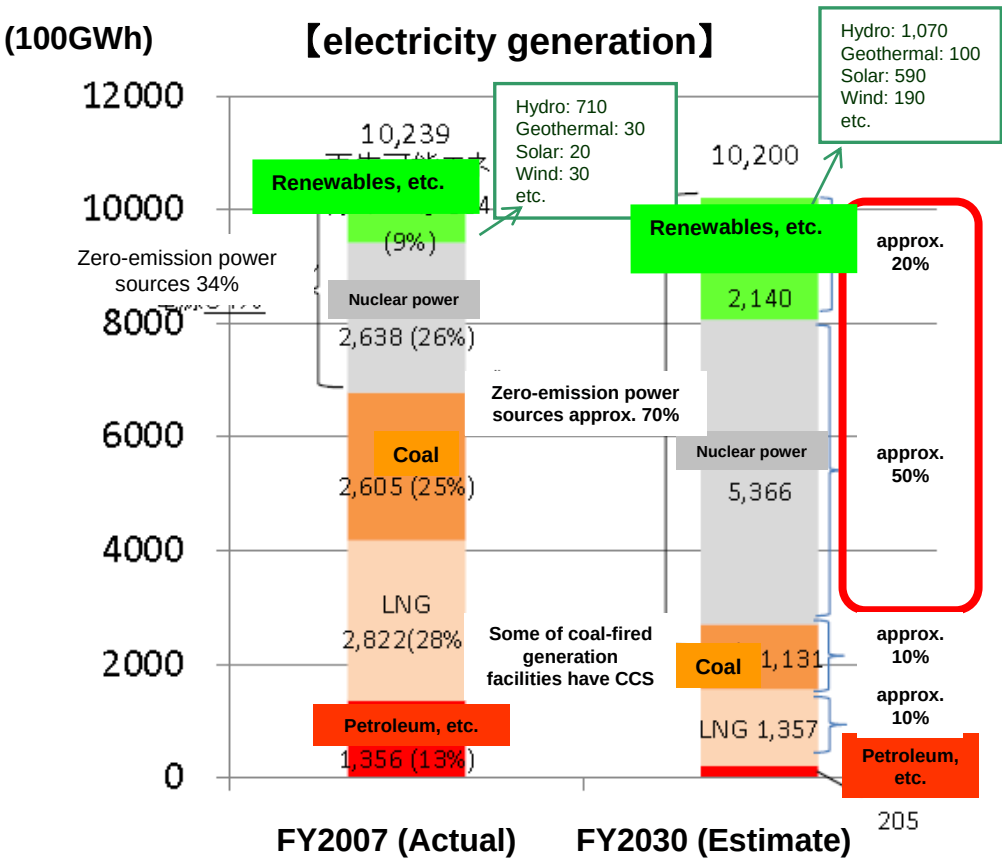
○ **Reduce CO2 emissions by 30% from 1990 level.**



Reference: Basic Energy Plan: Composition of Power Sources

- New construction and extension of 14 nuclear reactors; raise the operating rate from 60% to 90%.
- Introduce renewable energy to 2.4 times the current level (15 times excluding hydropower).
- Raise the share of zero-emission power sources from 34% to 70%.





2. Medium- to Long-Term Agenda

○ Review of the Basic Energy Plan ②

(2) Basic principles

- Importance of a comprehensive perspective
- Comprehensive perspective
  - a. Standpoint of security
  - b. Standpoint of global warming
  - c. Standpoint of costs
  - d. Standpoint of available potential reserves/energy density, etc.
- Unfortunately, there is no energy which can satisfy the first four standpoints.
  - ◇ Oil has problems concerning all of a, b and c.
  - ◇ Gas is superior to oil concerning a and b, while it is related to oil concerning c.
  - ◇ Coal is superior to oil concerning a and c, but has significant problems concerning b.
  - ◇ Photovoltaic power has advantages concerning a and b, but problems concerning c and d.
  - ◇ Wind and geothermal power, etc. have advantages concerning a, b and c, but problems concerning d.

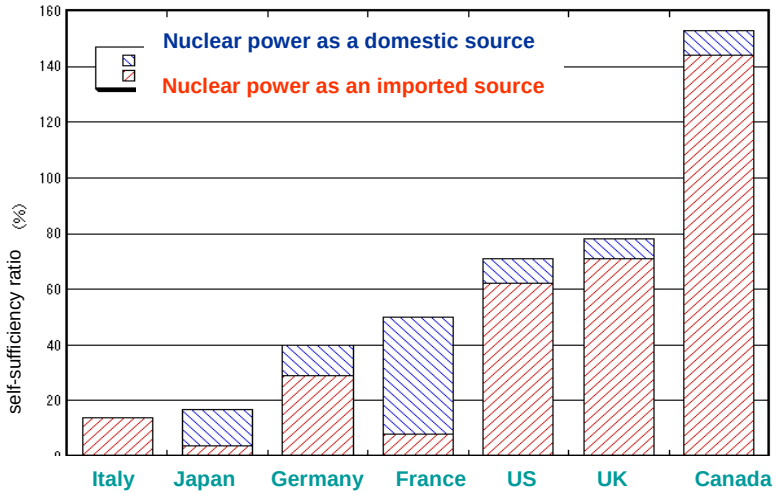
Note: Photovoltaic power requires a land area equivalent to that inside the Yamanote Line in order to generate 1 million kW of electricity.

Wind power requires 3.5 times more land area than photovoltaic power.

2. Medium- to Long-Term Agenda

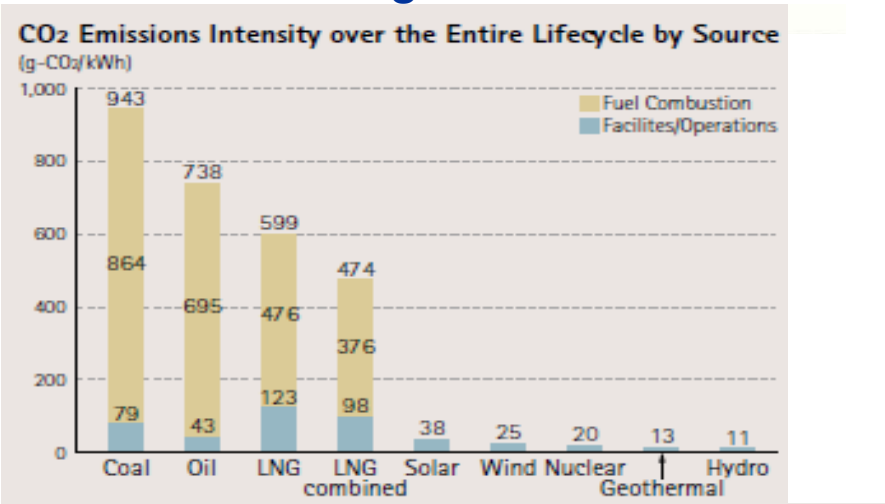
○ Review of the Basic Energy Plan ③

◆ Security



Energy White Paper

◆ Global warming

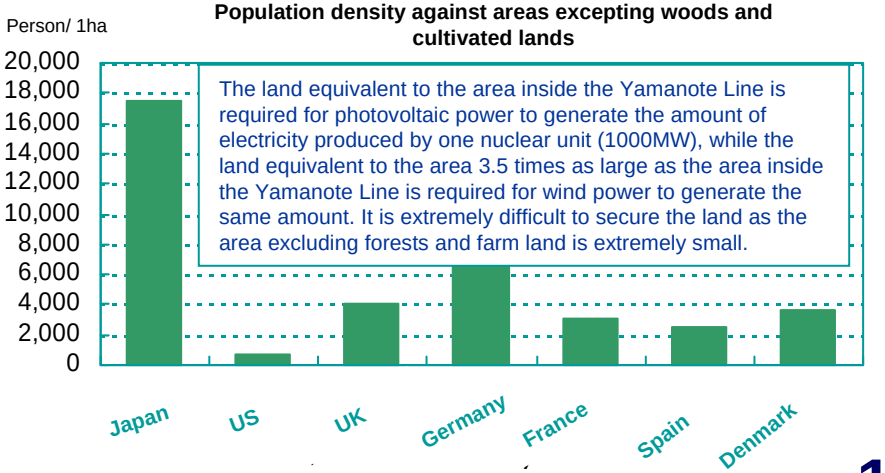


◆ Costs

Power Source	Generation Cost (yen/kWh)	Capacity Factor (%)
Hydro	8.2~13.3	45
Oil	10.0~17.3	30~80
LNG	5.8~7.1	60~80
Coal	5.0~6.5	70~80
Nuclear	4.8~6.2	70~85
Solar	46	12
Wind	10~14	20

Source: White Paper on Energy, METI

◆ Energy density



Prepared by IEE

2. Medium- to Long-Term Agenda

○ Review of the Basic Energy Plan ④

(3) Nuclear energy policy

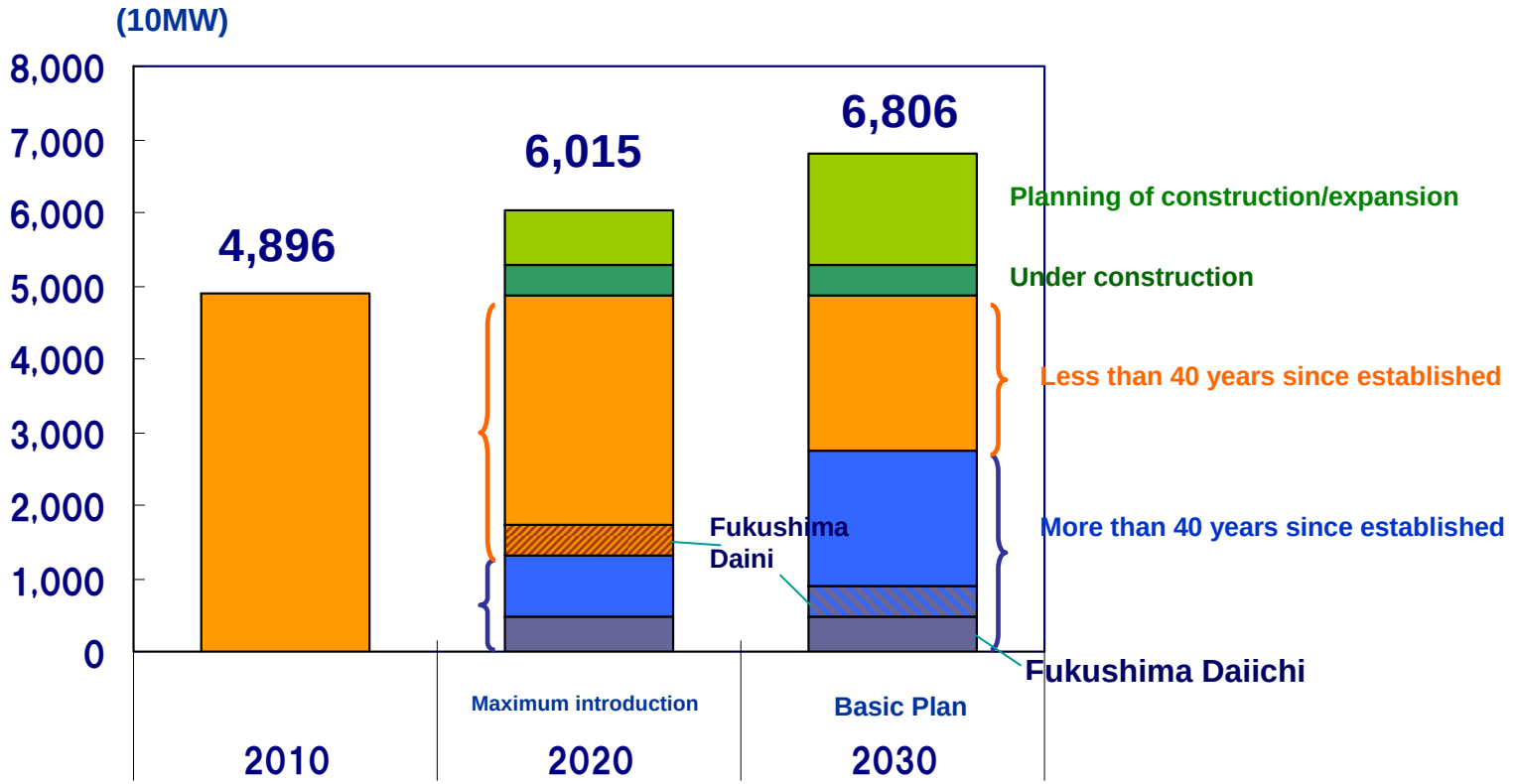
- Four comprehensive standpoints: Nuclear energy has advantages concerning all of a to d.

- However, all possible safety measures must be taken to achieve safer nuclear energy.
  - A meticulous study to identify the cause of the current accident (earthquake, tsunami or other factor?) is essential.
  - Safety must be secured through international cooperation.
    Best practices must be shared among operators.

- Global perspective is also important.
  - How and on what grounds does each country implement respective policies?

- Risk management
  - Must assume unexpected problems.

Reference: Installed Capacity of Nuclear Energy



	2010	2020	2030
Planning of construction/expansion		741	1532
Under construction		414	414
Less than 40 years since established	4,896	3,555	2,122
Fukushima out of above	910	440 (Daini)	0
More than 40 years since established		1,305	2,738
Fukushima out of above		470 (Daiichi)	910 (Daiichi and Daini)

2. Medium- to Long-Term Agenda

○ Review of the Basic Energy Plan ⑤

(4) Energy conservation policy 1

- Four standpoints: This policy has advantages concerning 3 standpoints except d) potential reserves.

- Make Japan's advantages even stronger. (see next page)

  A 10% electricity saving is equivalent to 13,500MW of nuclear power and 95,000MW of photovoltaic power.

- Especially, there is still huge scope for conserving energy in households and workplaces, which will also boost industrial competitiveness.

  (High performance, new materials, new products)

- But there may be limits on energy conservation by industry as it has already made the greatest progress.

- It is also important to convert the industrial structure, and to change life styles and work styles.

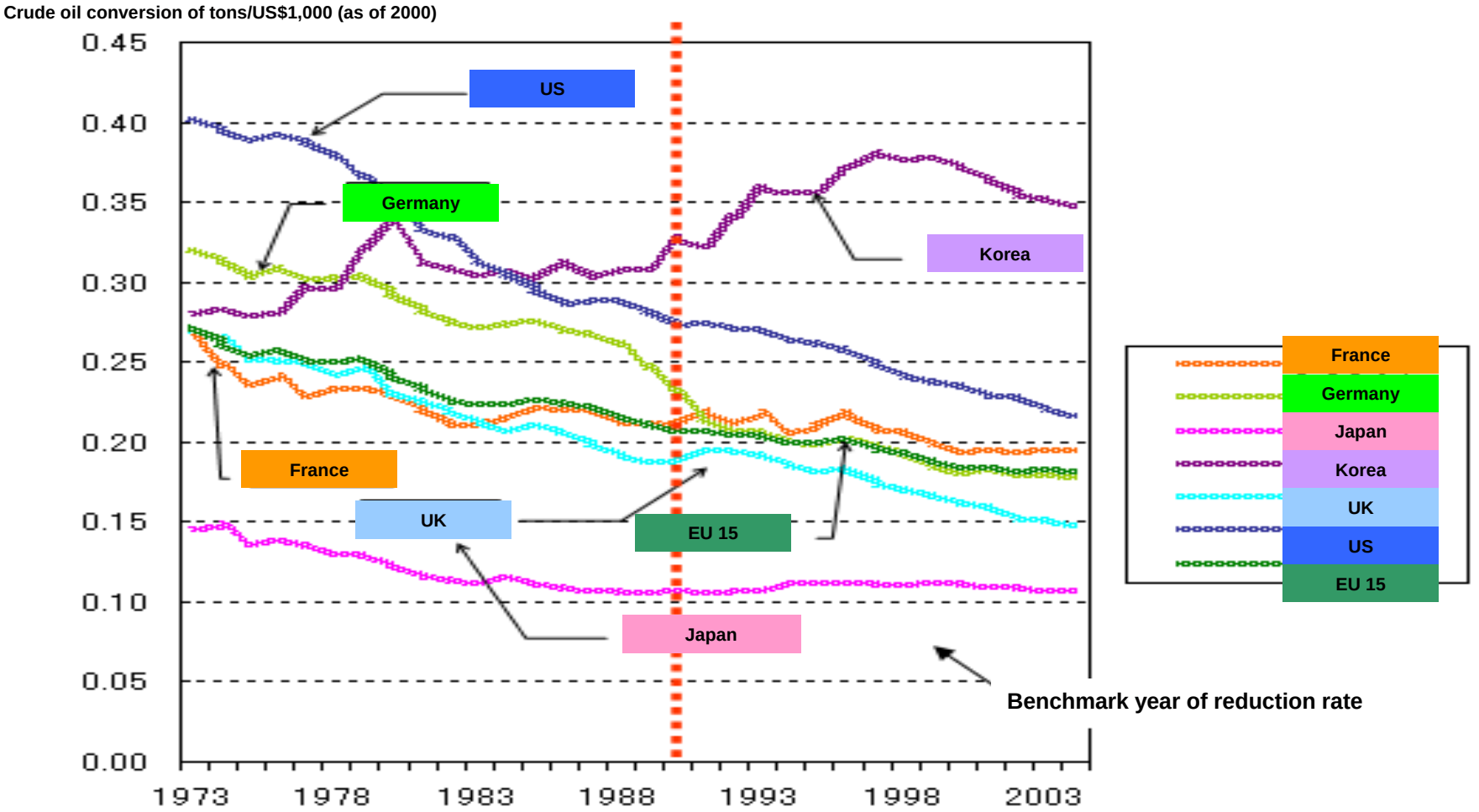
  (The current energy conservation efforts will serve as a trigger.)

2. Medium- to Long-Term Agenda

○ Review of the Basic Energy Plan ⑥

(4) Energy conservation policy 2

Trend of energy consumption intensity by country



Source: Website of Agency for Natural Resources and Energy

2. Medium- to Long-Term Agenda

○ Review of the Basic Energy Plan ⑦

(5) Renewable energy policy

- Maximum introduction of especially photovoltaic power, wind power and geothermal power is necessary.
- Comprehensive perspectives: c) costs and d) energy density are challenges to be solved.
- How much renewable energy can be stably supplied to the grid and by how much can costs be reduced by systems such as storage batteries, smart grids and mega solar systems?
- How to deal with the physical limitation concerning the relation between c and d?

Reference: Impacts of a 1GW Nuclear Unit

Impact of 1GW power station
- Nuclear v.s Renewables-

		Capacity factor (%)	power generation, GWh	CO2 reduction (Mt)	Initial cost (Billion JPY)	power generation cost (JPY/kWh)	To replace 1GW nuclear power plant,	
							capacity (GW)	Area
PV	1GW	12.0	1,051	0.7	520	49.5	7.1	67 km2
WIND (onshore)	1GW	20.0	1,752	1.1	190	10.8	4.3	235 km2
WIND (offshore)	1GW	30.0	2,628	1.6	250	9.5	2.8	
Small Hydro	1GW	80.0	7,008	4.3	1,600	22.8	1.1	
Geothermal	1GW	70.0	6,132	3.7	850	13.9	1.2	
Nuclear	1GW	85.0	7,446	4.5	300	6.5	1.0	
(Thermal Power Generation)								
LNG	1GW				164	7.5		
Coal	1GW				272	5.8		

Energy conservation in the Demand side

Energy conservation (10% electricity saving)
equal: Nuclear: 13.5GW
PV: 95GW

Reference: Outlook for Renewable Energy (Corresponding to the Basic Plan)

	2008	2020	2030	ISEP 2020
PV	Capacity			
	2.14GW	27.6GW	55.9GW	81GW
	Residential use	16.6GW	39.4GW	—
	Non residential use	11GW	16.5GW	—
Wind	Capacity			
	1.86GW	5GW	10GW	40GW
	On-shore:1.86GW	5GW	8GW	—
	Off-shore:0GW	—	2GW	—
Geothermal	Capacity			
	0.53GW	0.7GW	1.65GW	3.4GW

Outlook of ISEP: from “Unplanned blackout” to “Strategic energy shift”, on May 6, 2011

Reference: **Installation of Photovoltaic Power Generation by Households (Corresponding to the Basic Plan)**

・It is estimated that 12 million households will install photovoltaic power generation systems.
・It is estimated that photovoltaic power in non-residential facilities will increase to 55 times the current level.

1. Potential for installation

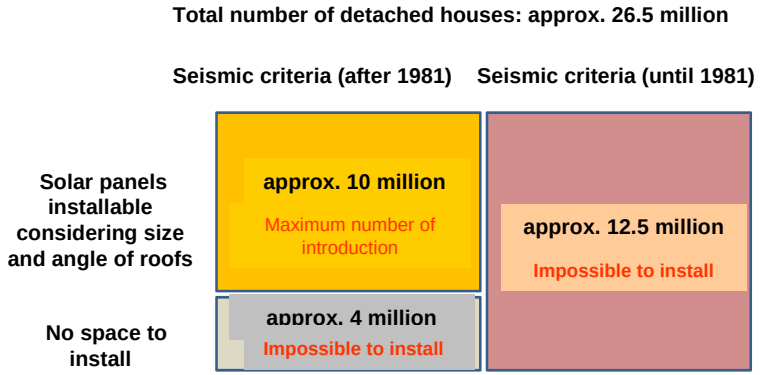
- According to the "PV Roadmap toward 2030+ (PV2030+)" by NEDO, there is potential of 54,000MW to 200,000MW for Japan as a whole.
  According to the Ministry of the Environment (in FY2010), the potential for non-residential facilities is estimated to be 59,000MW to 150,000MW.

- The number of detached houses which could install solar panels is a maximum of 10 million (35,000MW – 40,000MW) in view of seismic standards, installation locations, etc.
- Considering solar water heater units too, the limit will be even smaller.

2. Pace of installation

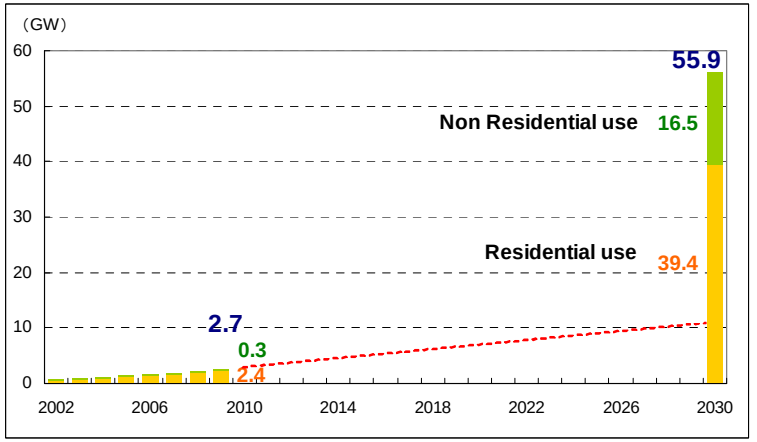
- At the pace of 150,000 houses in FY2009.
- Although the surplus electricity purchase price system is in place, it is necessary to install PV systems in 550,000 houses per year to reach 12 million houses by 2030. This means that PV systems must be made mandatory for all new houses.

Reference: **Limit on installing PV power generation systems for detached houses**



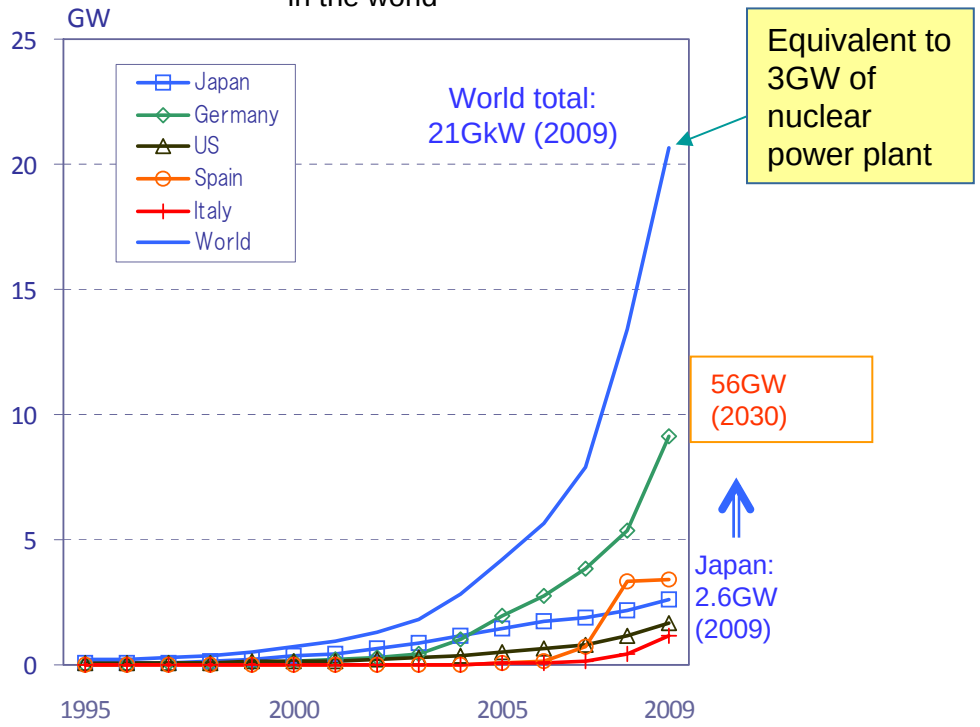
Analyzed by Prof. Yuhara of Tokyo University, Member of Mid-Term Target Investigation Committee

< Cumulative Installation of PV >



Reference: Installation Status of PV Power Generation

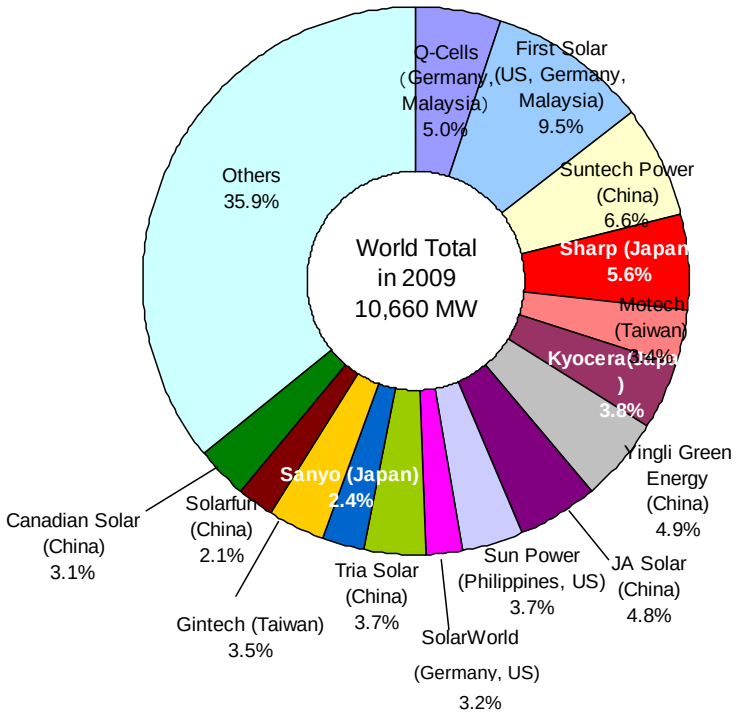
Installation status of PV power generation in the world



Note: The "world" means all countries participating in IEA-PVPS.

Source: IEA-PVPS "Trends in Photovoltaic Applications – Survey report of selected IEA countries between 1992 and 2008"

PV power generation module manufacturers in the world (2009)



Source: IEA "Trends in Photovoltaic Applications – Survey report of selected IEA countries between 1992 and 2008"

- The total cumulative installed capacity in the world is 20,630MW. Japan ranked top in the world until 2004 by cumulative installed capacity. However, following the introduction of the Feed-in Tariff (FIT) system, Germany and Spain are now first and second.
- Japanese companies produced almost half of all solar power generation panels up to 2005, but the share has gradually declined and German, Chinese and U.S. manufacturers have increased production.

Reference: Installation of Wind Power Generation (Corresponding to the Basic Plan)

・Installing 10,000MW by 2030

1. Potential scale of installation
   - ➢ The potential for constructing onshore wind power generation units is 6,400MW according to NEDO's estimation. Therefore, it is necessary to select large sites in nature parks or offshore areas in order to install 1,000MW.
   - ➢ The construction potential assumed by the National Institute for Environmental Studies is considered to be excessive. For example, the Institute assumes that wind power units will be installed in woodlands while constructing access roads of up to 10km. Will such a program be permitted in terms of nature conservation?

2. Siting restrictions, etc.
   - ➢ There are issues to be solved such as preservation of natural landscapes, prevention of noises and bird strikes, etc. It is necessary to negotiate with local residents, so a rapid increase is difficult. Fishing rights is another issue concerning offshore wind power generation units.
   - ➢ It is estimated that planning to start of construction takes 6 to 9 years due to environmental assessments.
   - ➢ There are few suitable places for hosting wind power units due to geographic and wind conditions. Therefore, investigation of installation potential based on the natural conditions in Japan is necessary.

3. Cost of installation
   - ➢ Although onshore wind power generation costs are already globally competitive, system costs are rising as suitable locations decrease due to the rapid increase in worldwide demand and facility installation.

4. Other challenges
   - ➢ Due to volatility, the same as for PV power generation systems, Japanese electric utilities place an upper limit on the interconnection capacity of the wind power generation system. Measures to upgrade interconnection capacity is a significant challenge for the future.

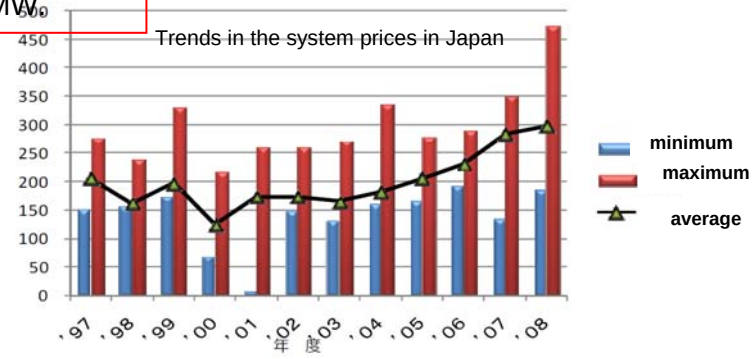
Estimated wind power generation potential

(MW)

	JWPA	MOE
Onshore	168,900	300,000
Offshore(bottom-mounted)	93,830	310,000
Offshore(floating)	519,490	1,300,000
Total	782,220	1,900,000

Maximum capacity is estimated to be 5 million MW.

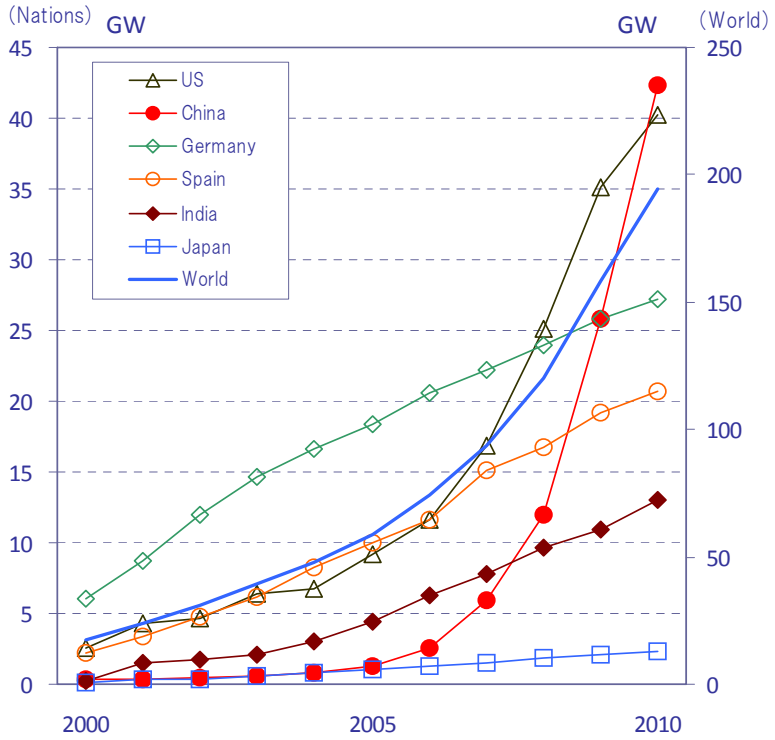
Source: White Paper on Renewable Energy Technologies published by NEDO



Source: New and Renewable Energy Subcommittee of the Advisory Committee for Natural Resources and Energy

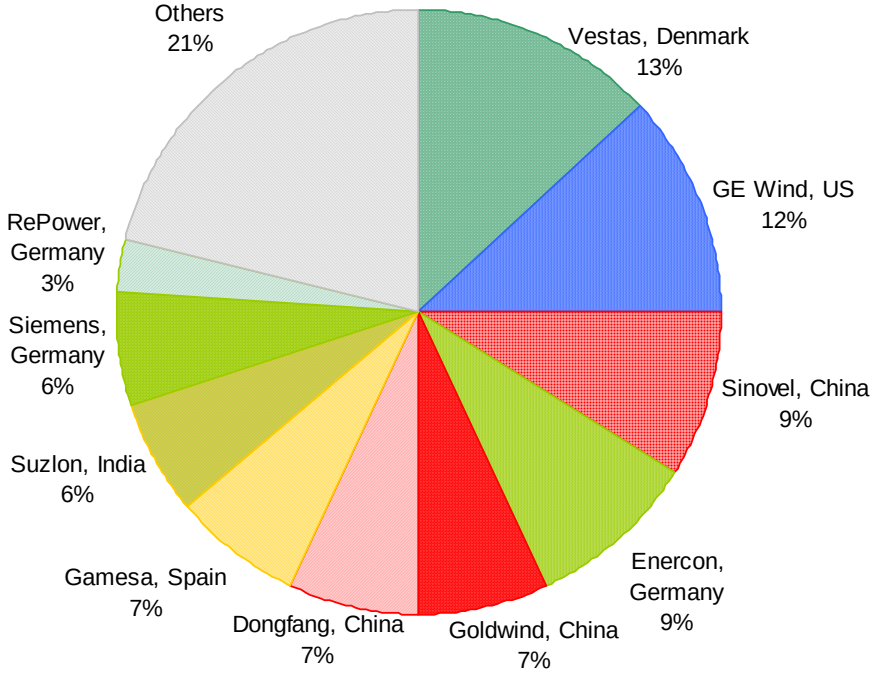
Reference: Installation Status of Wind Power Generation

Installation status of wind power generation in the world



Source: Global Wind Energy Council
"Global Wind Report" 2010

Share of wind power generation units in the international market (2009)



Source: REN21"RENEWABLES 2010 GLOBAL STATUS REPORT"

- The global cumulative installed wind power capacity as of the end of 2009 was 158.500MW, up 32% from a year ago. The U.S., Germany and Spain have been active, but now China and India have been significantly expanding installed capacity.
- Although Vestas (Denmark), GE Wind (U.S.) and Gamesa (Spain) accounted for 50% of global wind power generation units in 2008, Chinese manufacturers grew strongly in 2009. Among Japanese manufacturers, Mitsubishi Heavy Industries has expanded its share in both the domestic and U.S. markets.

Reference: Installation Status and Production Trend of Geothermal Power Generation System

■Installation has been expanding in the U.S., Indonesia, etc.

■Challenges for installation in Japan

・Although current installed capacity is 530MW, the corresponding Basic Plan assumes a cumulative capacity of 1,650MW which is perhaps the upper limit of the potential in 2030. However, there has been no new development in the last decade.

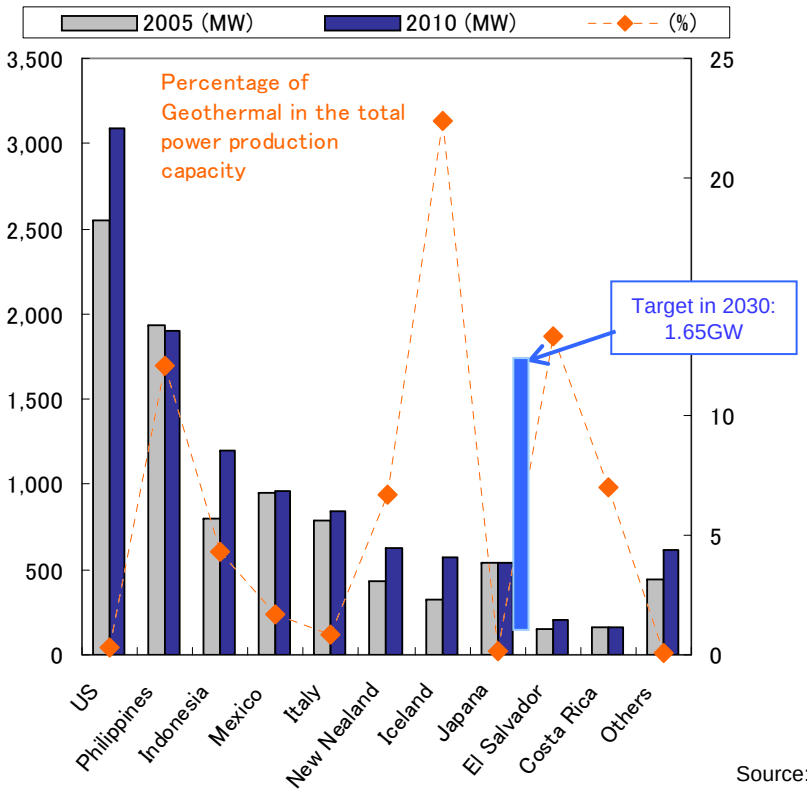
・Development risk is high due to the need for confirming the underground heat source by boring tests.

・There are siting restrictions due to conflicts of interest with national parks and utilization of hot springs.

■Japanese manufacturers have a large share in the world market.

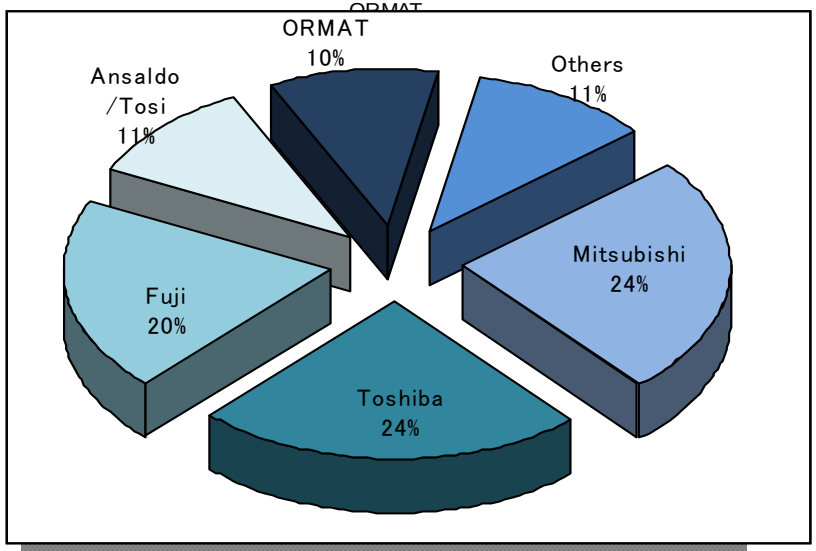
Installation status of geothermal power generation

(Note) Total power generation capacity is the value of 2008 (EIA).



Major manufacturers of geothermal power generation system

Cumulative value



Potential of geothermal power generation

Cost of power generation Up to ¥12/kWh: 1,100MW

Cost of power generation Up to ¥15/kWh: 1,460MW

Cost of power generation Up to ¥20/kWh: 1,650MW

Source: Prepared based on the “Study on the Low-Carbon Electricity Supply System”

2. Medium- to Long-Term Agenda

○ Review of the Basic Energy Plan ⑧

6) Fossil Fuel Energy Policy

- Comprehensive perspective: It has problems concerning a, b and c (security, warming and costs).
- Among fossil fuels, the problems of natural gas are relatively small, but the problems of global warming gases cannot be avoided.
- It is necessary to accelerate the development of CCS, but:
  - There are little suitable sites in Japan.
  - Transportation by ship is essential.
- Idea of CCU (Carbon Capture and Use) is also important.
  (Note: Remark by Dr. Eiichi Negishi)

2. Medium- to Long-Term Agenda

○ Review of the Basic Energy Plan ⑨

7) Important points

(1) The starting point should be the recognition that Japan has few energy resources.

(2) Comprehensive studies are essential:

a. Security : Independently developed energy or not

b. Global warming : Amount of CO2 emissions

c. Costs : Effects on industrial competitiveness

d. Available reserves/energy density : Physical limit

(3) There is no perfect energy which can replace nuclear energy. It is necessary to diversify energy sources and to promote technological development based on safety.

(4) It is important to mix safer nuclear energy, cheaper renewable energy and cleaner fossil fuels (especially, natural gas and clean coal) and to promote energy conservation.

(5) It is essential to internationally standardize the safety criteria and to share best practices through international cooperation for assuring the safety of nuclear energy and risk management.

Thank you for your attention!

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