Toward Expanding New Energy Introduction

May 2004

Agency of Natural Resources and Energy

Japan's Energy Supply Trend

Characteristics

- As to Japan's energy supply, domestic coal lost competitiveness in the 1960s, **which was substituted by oil, and oil accounted for the majority of primary energy supply, at 80%.**
- After the two Oil Crises in the 1970s, **introduction of oil-alternative energy**, such as foreign coal, natural gas, and nuclear power, **under an oil-alternative policy, was promoted, and oil dependency significantly decreased, to about 50%** (from 77% in FY1973 to 52% in FY2000).
- In the 1990s, needs for higher efficiency in energy supply increased, but due to restricted supply of nuclear and renewable energy, **the majority of energy supply necessary for economic growth was still fossil fuels**.

Fossil fuel dependency rate: 85% (FY1990) to 83% (FY2000)

GDP elasticity value of fossil fuel supply volume: 0.4 (1980s) to 0.9 (1990s)

【Change in primary energy supply】

(%)

	FY1973	FY1990	FY2001
Primary energy supply (million kl of crude oil equivalent)	414	520	558
Oil	77	57	49
Coal	15	17	19
Natural gas	2	10	13
Nuclear	1	10	13
Hydro	4	4	3
Geothermal	0	0.1	0.1
New energy, etc.	1	2	2

Source: Comprehensive Energy Statistics

Note: Numbers for FY1990 and thereafter were taken from the New Energy Balance Table.

【Relation between GDP and primary energy supply】

Period	Yearly average growth rate (%)				Primary energy supply versus GDP elasticity value	Fossil fuel supply versus GDP elasticity value	Energy-originating CO_2 emissions versus GDP elasticity value
	Primary energy supply	Fossil fuel supply	Energy-originating CO_2 emissions	GDP			
1960～1970	12.2%	14.0%	-	10.0%	1.2	1.4	-
1970～1980	2.2%	1.8%	1.9%	4.4%	0.5	0.4	0.4
1980～1990	2.0%	1.6%	1.3%	4.2%	0.5	0.4	0.3
1990～2000	1.4%	1.1%	1.0%	1.3%	1.1	0.9	0.7

Source: Surveyed by the Agency of Natural Resources and Energy

【Change in electric energy generated by electric sources in Japan (for general electric industry)】

(%)

	FY1973	FY1990	FY2001
Generated electric energy (1 billion kWh)	379	738	924
Oil-fired power	73	29	8
Coal-fired power	5	10	21
LNG-fired power	2	22	27
Nuclear	3	27	35
Hydro	17	12	9
New energy	–	–	0.3

Source: Electric Power Supply Plan

Reduction of Energy-Originating CO_2 Emissions and Energy Supply Outlook

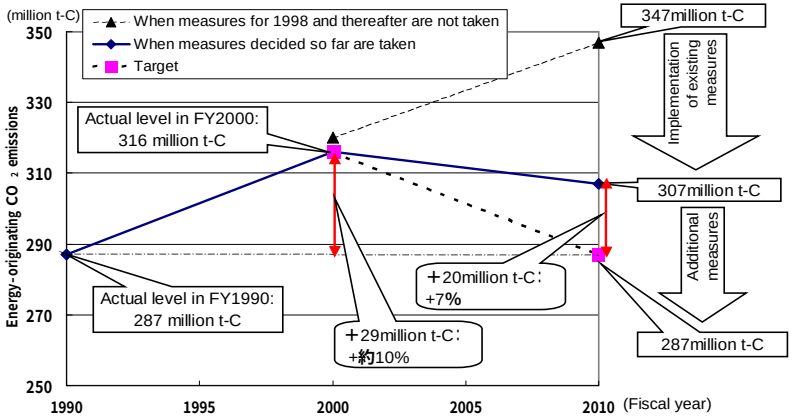
Goal

About 90% of emitted greenhouse gas is energy-originating carbon dioxide. The goal is to reduce CO_2 emissions to the 1990 level, by fiscal 2010 (Global Warming Measures Promotion Outline)

Problems

[Demand aspect] Consistent growth mainly in the commercial/residential and transportation sectors

[Supply aspect] Prolongation of the nuclear power plant establishment project



- Energy conservation / new energy measures
- Implementation of Keidanren's independent action plan
- Promotion of nuclear power policy, etc.

Energy conservation:
- 6 million t-C
New energy:
- 9 million t-C
Fuel change, etc.:
- 5 million t-C
Total: - 20 million t-C

Source: report by the Advisory Committee on Energy and Natural Resources

Target of greenhouse gas measures

(Point)

Reduction of energy-originating CO_2 to about 287 million t-C (FY1990 level)

▲2.5%	Reduction of emissions of CO_2, methane, and dinitrogen monoxide
	(Among them) ±0%: reduction of energy-originating CO_2
	If no additional measures are taken (simple maintenance of present measures) Exceeds by about 20 million t-C
	Measures: Energy conservation: ▲6 million t-C; New energy: ▲9 million t-C; Others (fuel change, etc.) ▲5 million t-C
▲3.9%	Change of land usage and absorption by forest activities
+2.0%	Reduction of emissions of CFCs substitutes (HFC, PFC, SF6)
Remains (or Rest) ▲1.6%	Joint measures and use of emission permit transactions, etc.

Primary energy supply outlook

(Point)

Oil dependency rate: reduction to about 45% by FY2010

Item \ Fiscal year	1999 (composition ratio)	2010 (composition ratio)
Oil	52%	About 45%
Coal	17%	About 19%
Natural gas	13%	About 14%
Nuclear	13%	About 15%
Hydro	4%	About 3%
New energy	1% ⇒	About 3%

Outlook on electric energy generation (electric enterprises)

(Unit: 100 million kWh)

Fiscal year	1999		2010	
Electric energy generated	9176		About 9970	
By power source	Actual number	Composition ratio (%)	Actual number	Composition ratio (%)
LNG	2405	26.2	About 2549	About 26
Coal	1529	16.7	About 1599	About 16
Oil, etc.	1129	12.3	About 533	About 5
Nuclear	3165	34.5	4186	About 42
Hydro	893	9.7	962	About 10
Geothermal	34	0.4	37	About 0.4
New energy	21	0.2	115	About 1
CO_2 emission basic unit (g • C/kWh)	89.9		About 73.6	

Definition of New Energy

What is new energy?

As to new energy, “use, etc., of new energy” is stipulated in the Special Measures Law on Promoting Use of New Energy, which was enforced in 1997, and new energy is positioned as something that Japan should aggressively promote introduction of, as policy support, as follows:

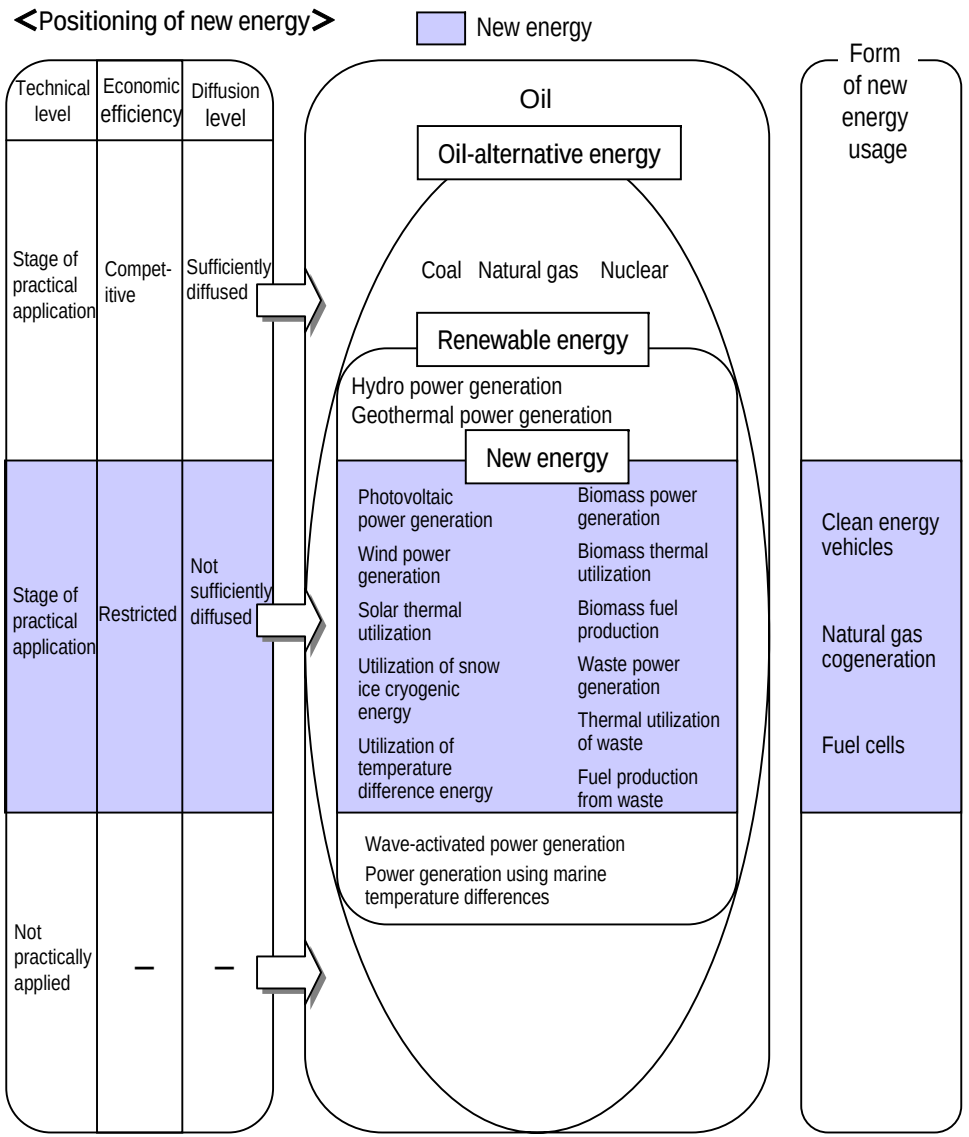
(1) among manufacturing, generation, use, etc., of oil-alternative energy,
(2) energy that is not being spread due to economic restriction,
(3) energy that especially contributes to the promotion of oil-alternative energy.

Specifically, new energy resources include the following:

- **New energy on the supply side**
  (Power generation field)
  - Photovoltaic power generation
  - Wind power generation
  - Waste power generation
  - Biomass power generation

  (Thermal field)
  - Solar thermal utilization
  - Thermal utilization of waste
  - Biomass thermal utilization
  - Utilization of snow ice cryogenic energy
  - Temperature difference energy

  (Power generation / heat)
  - Fuel production from waste
  - Biomass fuel production
- **New energy on the demand side**
  - Electric vehicles (including hybrid), natural gas vehicles, methanol vehicles
  - Natural gas cogeneration
  - Fuel cells



Significance of Introducing New Energy

New energy has various significances, such as contributing to the construction of a sustainable economic society, and the creation of new industries and employment, etc., and contributing to securing stable energy supply and addressing global environmental problems, as energy resources with low restriction, and as oil-alternative energy that contributes to lowering oil dependency, and that places a low burden on environment, such as low emission of carbon dioxide.

○Oil-alternative energy that contributes to securing stable energy supply
- Domestically produced energy facilitating stable energy supply, on which less resource constraint is imposed.
- Oil-alternative energy that reduces oil dependency

○Clean energy with less environment impact
- Clean energy with less environment impact compared with fossil energy (new energy on the supply side)
- If energy efficiency is high, consumption of fossil energy can be reduced (new energy on the demand side)

○Contribute to the creation of new industry and employment
- High potential for creating new markets and employment in the process of developing new technology and products
- Contribute to strengthening the competitiveness of Japanese companies

○Benefits of a distributed energy system
- Can be used as a stand-alone energy system independent from commercial power distribution, in the event of an emergency, such as a disaster.
- Can be installed near where energy is needed, resulting in reduced energy loss during electric power transmission.

○Potential for leveling the power consumption (reducing peak consumption)
- It is possible to level power consumption by operating the photovoltaic power generation system, etc., during the daytime in the summer.

Actual Result of Introducing New Energy, and Introduction Targets

As a result of study based on the maximum efforts of governments and the people, the “new energy introduction target,” on the supply side, was newly set at 19.1 million kl, in terms of crude oil (the rate in the total primary energy supply is about 3%).

New energy on the supply side

		FY2000	FY2010 target
Power generation field	Photovoltaic power generation	156,000 kl (637,000 kW)	1,180,000 kl (4,820,000 kW)
	Wind power generation	189,000 kl (463,000 kW)	1,340,000 kl (3,000,000 kW)
	Waste power generation	1,520,000 kl (1,400,000 kW)	5,520,000 kl (4,170,000 kW)
	Biomass power generation	226,000 kl (218,000 kW)	340,000 kl (330,000 kW)
Thermal utilization field	Solar thermal utilization	740,000 kl	4,390,000 kl
	Thermal utilization of waste	60,000 kl	140,000 kl
	Biomass thermal utilization	—	670,000 kl
	Unused energy (*)	36,000 kl	580,000 kl
	Black liquid, waste material, etc. (*)	4,710,000 kl	4,940,000 kl
Total (rate in total primary energy supply)		7,640,000 kl (1.2%)	19,100,000 kl (about 3%)

Demand-side new energy sources

	FY2002	FY2010 target
Clean energy vehicles (*)	139,000 vehicles	3,480,000 vehicles
Natural gas cogeneration (*)	2,150,000 kl	4,640,000 kl
Fuel cells	12,000 kl	2,200,000 kl

* Unused energy includes snow ice cryogenic energy.
* Black liquid and waste material are classified as part of biomass and partially include those used for power generation.
* Clean energy vehicles include the following types of vehicles: electric, fuel-cell, hybrid, natural gas, methanol, and diesel-alternative LP gas.
* Natural gas cogeneration includes fuel cell cogeneration.

Note: Primary energy total supply is the FY2001 value (from General Energy Statistics).

International Comparison of Results of New Energy Introduction

International comparison of photovoltaic and wind power generation

Installed capacity (unit: 10,000 kW)					
Photovoltaic (as of the end of December 2002)			Wind (as of the end of December 2002)		
① **Japan**	63.68	48.5%	① Germany	1,090.0	37.4%
② Germany	27.73	21.1%	② US	470.8	16.2%
③ US	21.22	16.2%	③ Spain	407.9	14.0%
④ Australia	3.91	3.0%	④ Denmark	288.9	9.9%
⑤ Netherlands	2.63	2.0%	⑤ India	170.2	5.8%
⑥ Italy	2.20	1.7%	⑥ Italy	75.5	2.6%
⑦ Switzerland	1.95	1.5%	⑦ Netherlands	67.7	2.3%
⑧ France	1.72	1.3%	⑧ UK	55.2	1.9%
⑨ Mexico	1.62	1.2%	⑨ China	39.9	1.4%
⑩ Canada	1.00	0.8%	⑩ **Japan**	35.1	1.2%
⑪ Austria	0.90	0.7%	⑪ Sweden	31.0	1.1%
⑫ Norway	0.64	0.5%	⑫ Greece	27.6	1.0%
⑬ Korea	0.54	0.4%	⑬ Canada	22.1	0.8%
⑭ UK	0.41	0.3%	⑭ Portugal	17.1	0.6%
⑮ Sweden	0.33	0.3%	⑮ France	14.7	0.5%
⑯ Finland	0.31	0.2%	⑯ Ireland	13.8	0.5%
Global total	131.17	100%		2,914.0	100%

Note: The value on wind power for Japan is based on the survey by NEDO (as of the end of March 2002).

Source:

- The record of photovoltaic power generation at the end of December 2002 is from IEA/PVPS.
- "Wind Power Monthly April 2001" for the result of wind power generation as of the end of December 2002.

Rates of renewable energies in the total energy supply volume in various countries

Renewable energy sources: solar, wind, waste, hydraulic [excluding pumped storage type], geothermal, etc.)

	Primary energy supply		Based on generated power volume	
	Record of 2001	Target for 2010	Record of 2001	Target for 2010
Japan	4.9%	About 7%	9.1%	About 11%
US	4.5%	6.9%	7.6%	9.2%
Canada	15.8%	–	57.9%	–
EU	6.0%	12.0%	15.9%	22.1%
UK	1.2%	–	2.6%	10.0%
France	7.0%	–	14.3%	21.0%
Germany	3.1%	–	7.6%	12.5%
Italy	5.7%	–	20.3%	25.0%
Denmark	11.1%	–	17.1%	29.0%
Sweden	30.0%	–	51.4%	60.0%
Austria	22.4%	–	70.5%	78.1%

Source:

- FY2001 record for Japan: surveyed by the Agency for Natural Resources and Energy
- 2010 target for Japan: report by the Advisory Committee on Energy and Natural Resources (July 2001).
- FY2001 record for overseas: "Energy Balance of OECD Countries 2000-2001"
- The above report for the U.S.A. 2010 target on total primary energy supply.
- EU command (September 2001) for the EU 2010 target.

Problems in New Energy Introduction and Efforts to Overcome the Problems (Output Stability)

Problems concerning output stability

Natural energy, such as photovoltaic power generation and wind power generation, is unstable in output because of dependency on sunshine, wind conditions, etc.

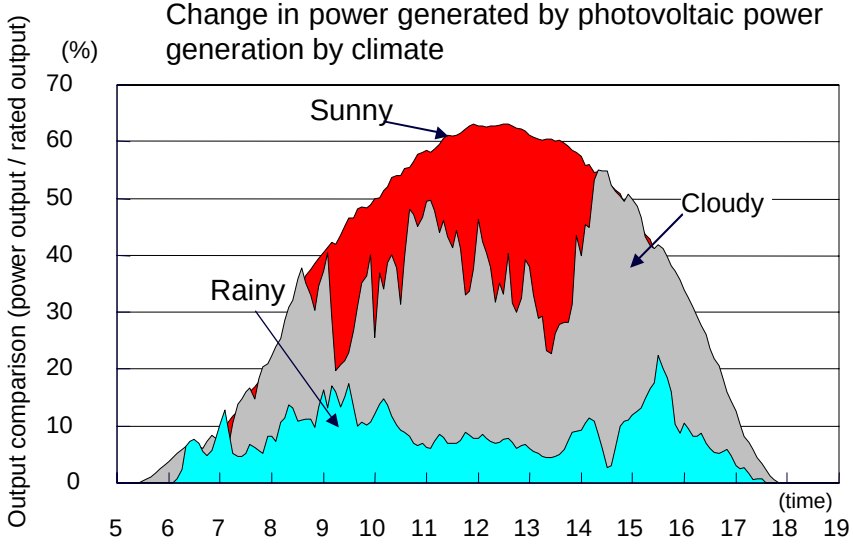
At present, therefore, these renewable energies are considered to be supplementary power sources, since power sources are expected to assure stable power, and, to ensure stable power supply, it is necessary to combine renewable energy with an adjustable power source or storage battery.

It is pointed out that general customers can also be affected through deterioration of electricity quality according to increased incorporation of new energy into electric systems, such as large-scale introduction of wind power generation, whose output is unstable.

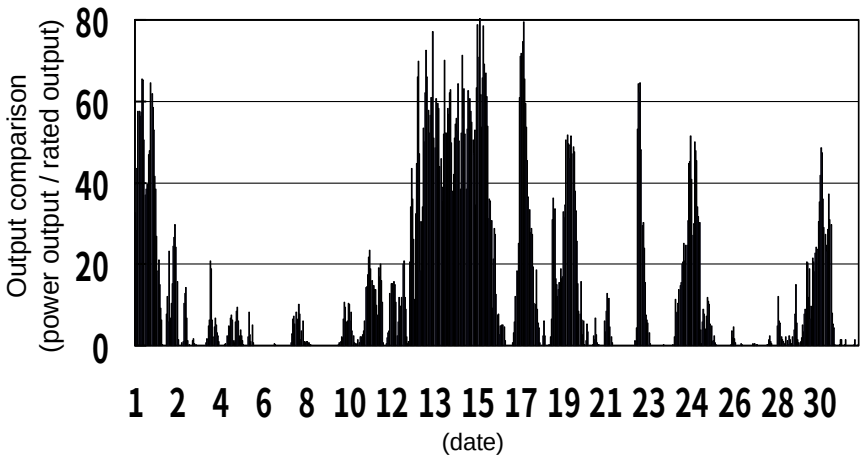
Efforts to overcome the problems

To conduct experimental study, etc., on the effects of voltage variation and frequency variation on the electric systems, regarding photovoltaic power generation and wind power generation combined with storage batteries.

Change in power generated by photovoltaic power generation by climate



Change in power output in August 1999 at Tappi Wind Park

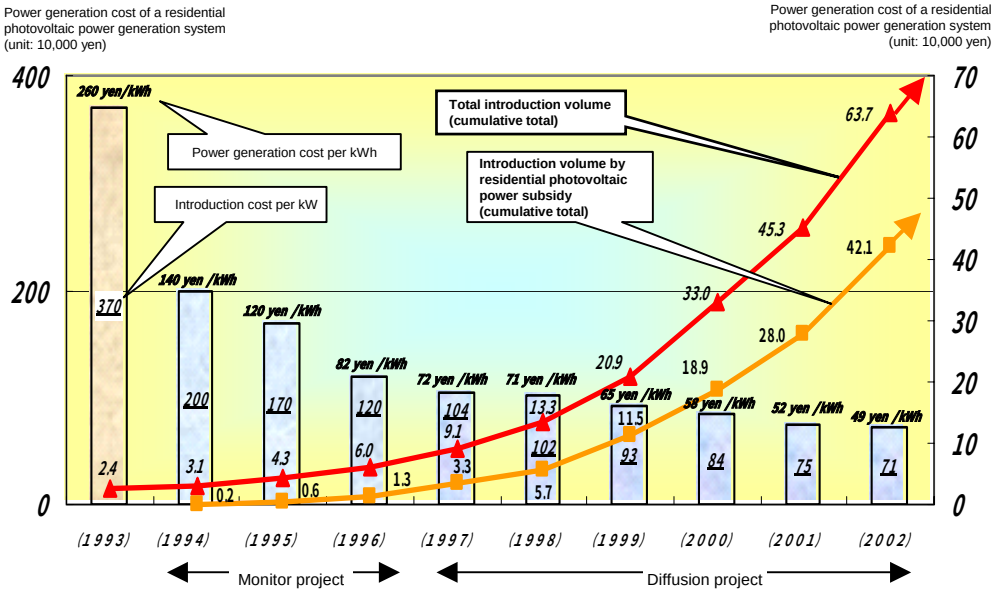


Problems in New Energy Introduction (Economic Efficiency)

Change in economic efficiency of residential photovoltaic power generation

Reduced the average system price to about 0.72 million yen /kW, which is about one-fifth of that of nine years ago (FY1993), through technological development achieved over the past 20 years, surplus electricity schemes by electric companies (from 1992), installation subsidy by the Government (from 1994), etc.

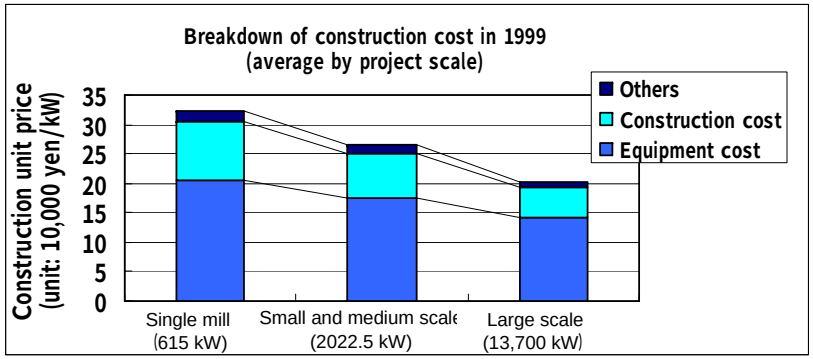
Change in Introduction Volume, Price, and Power Generation Cost of a Residential Photovoltaic Power Generation System

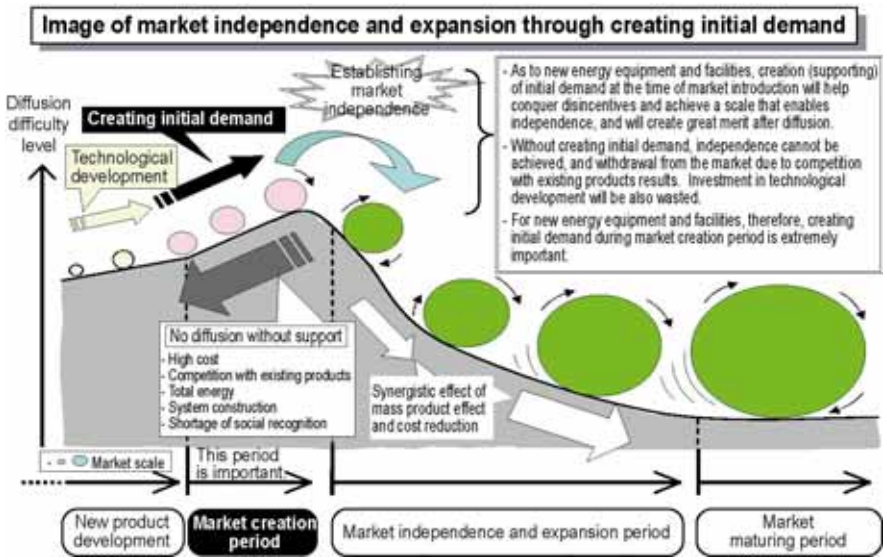


Source: Trial calculation by the Ministry of Economy, Trade and Industry, based on discussion with the maker, etc.

Relation between equipment scale and economic efficiency of wind power generation

As to wind power generation, generally, the larger the scale, the lower the installation cost. In recent years, equipment size and project scale have been increasing.





Policy Strengthening toward Expansion of New Energy Introduction

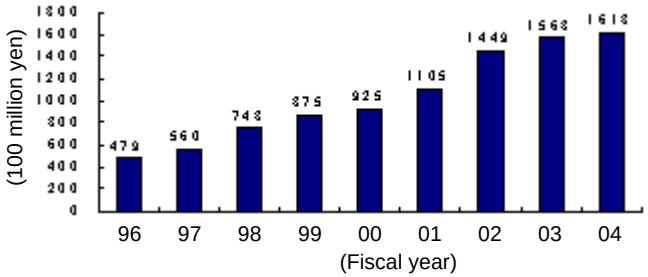
Legal aspect

Jan. 2002 Added two new energy sources: “biomass” and “snow ice,” to the new energy sources stipulated in the Law on Promoting Use of New Energy (in fiscal 2002, the Government began supporting projects to introduce these energies).

May 2002 Establishment of the “Special Measures Law on Promoting Use of New Energy, etc., by Electric Enterprises”. This Law made it obligatory, starting in April 2003, for electric enterprises to increase the power generation rate by new energy sources, such as photovoltaic power, wind power, and biomass.)

Budget aspect

● **Change in budget related to new energy** (the right figure)
Fiscal 2004 budget plan related to new energy: 161.3 billion yen
(an increase by 4.5 billion yen compared with the previous fiscal year; almost tripled in the past eight years)



● **Budget system** (the following table)

	Content	Project	FY2004 FY2003 for ( )
Technological development	Implementation of technological development regarding important development issues, to promote cost reduction and performance improvement of new energy technology	• Photovoltaic power generation-related (6.6 billion yen) • Wind power generation-related (1.0 billion yen) • Fuel cells-related (23.5 billion yen) • Biomass-related (6.0 billion)	About 42.4 billion yen (about 43.4 billion yen)
Experimental testing	Implementation of experimental testing for experimenting and confirming the effectiveness in actual use, through such as extraction, elucidation, and management of problems that would hinder practical application of developed technology and its market introduction, based on the results of technological development.	• Field test on new technology for photovoltaic power generation, etc. (5.0 billion yen) • Experimental study on integrated linkage-type photovoltaic power generation systems (5.9 billion yen) • Experimental testing on unused energy, such as biomass (2.9 billion yen) • Experimental study on proton exchange-type fuel cells (3.0 billion yen)	About 26.5 billion yen (about 18.8 billion yen)
Promoting introduction	Aiming to induce early independence in the market through mass production, regarding new energy in the stage of practical application, efforts should be made to create initial demand, and to support advanced new energy introduction by businesses, local governments, etc., thus promoting the spread of similar businesses.	• Support to introduce residential photovoltaic power generation systems (5.3 billion yen) • Support to introduce clean energy vehicles (10.9 billion yen) • New energy enterprise support measures (48.3 billion yen) • Regional new energy introduction promotion measures (11.0 billion yen)	About 92.4 billion yen (about 94.6 billion yen)

Outline on the Special Measures Law on Use of New Energy, etc., by Electric Enterprises

The law aimed to further expand introduction of new energy, etc., in the electric field, and to contribute to the securing of stable energy supply and environmental protection, by obligating electric enterprises to use electricity generated using new energy, etc., for a certain volume or more.
Common name: RPS (Renewables Portfolio Standard) Law (enacted in 2002)

◯ Types of applicable new energy, etc.
(1) Wind power, (2) sunlight, (3) geothermal energy (without remarkably reducing hot water), (4) small- and medium-size hydraulic power (conduit type; 1000 kW or less), (5) biomass
"Electricity of new energy, etc.": Electricity obtained from Minister-certified new energy, etc., generated at facilities that convert new energy, etc., into electricity

◯ Volume of electricity of new energy, etc., that must be used
- About 1.35% or more of the volume of electricity supplied, for all electric enterprises, in FY2010 (12.2 billion kWh nationwide, proportionally divided).
- Follow-up measures, considering the state of past use of electricity of new energy, etc., until FY2009.
- About 0.39% (about 3.3 billion kWh nationwide) of the volume of electricity supplied, as an average of ten general electric enterprises, for FY2003.

◯ Electric enterprises select the most advantageous method from among the following.
(1) To generate electricity of new energy, etc., on their own.
(2) To purchase electricity of new energy, etc., from another power generation enterprise.
(3) To purchase the volume equivalent to electricity of new energy, etc., from another power generation enterprise, etc.

* Volume equivalent to electricity of new energy, etc.: The volume that can be traded among enterprises, according to the volume of electricity of new energy, etc., used by another electric enterprise, to achieve the obligatory volume; and, the tradable volume supposedly corresponds to the value of the new energy volume. This trading enables fulfillment of the electricity obligation by using market functions even in regions where introduction of new energy is difficult.

◯ This obligation became effective in April 2003.

● **Electric enterprises (retail enterprises) applicable to obligation: a total of 28 companies**

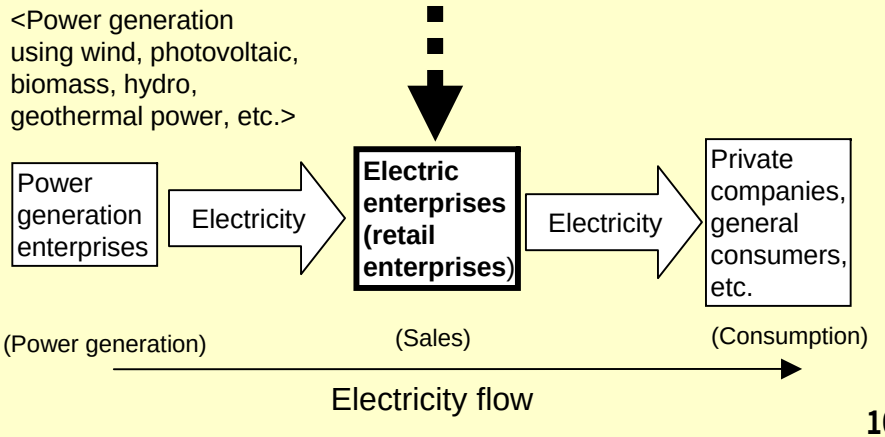
[General electric enterprises] a total of 10 companies

Hokkaido Electric Power Co., Ltd.	Tohoku Electric Power Co., Ltd.
Tokyo Electric Power Co., Ltd.	Chubu Electric Company, Incorporated
Hokuriku Electric Power Co.	Kansai Electric Power Co., Inc.
Chugoku Electric Power Co., Inc.	Shikoku Electric Power Co., Inc.
Kyushu Electric Power Co., Inc.	Okinawa Electric Power Co., Inc.

[Specific-scale electric enterprises, specific electric enterprises] a total of 18 companies

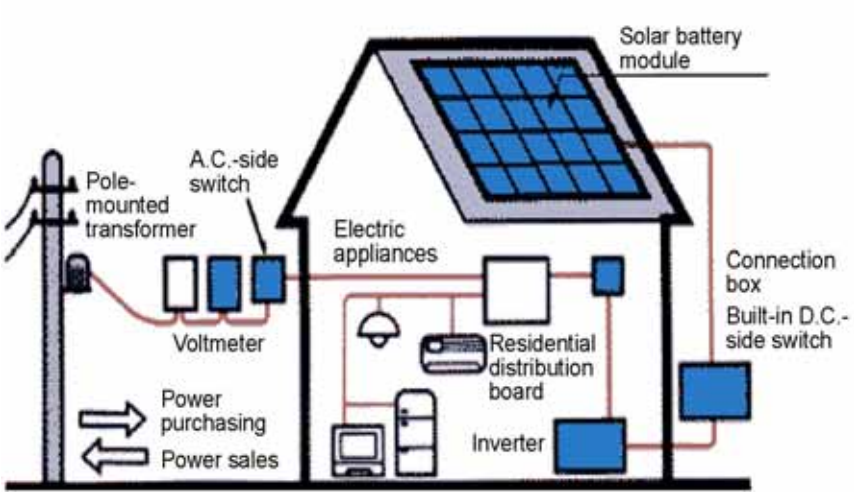
Diamond Power
E-LEX
Suwa Energy Service
Amagasaki Utility Service And others

(As of February 2004)



What is Photovoltaic Power Generation?

The method of generating power by using the phenomenon of electricity being generated when light is directed onto silicone semiconductor, etc., and directly converting solar energy into electricity by a solar battery (microchip).



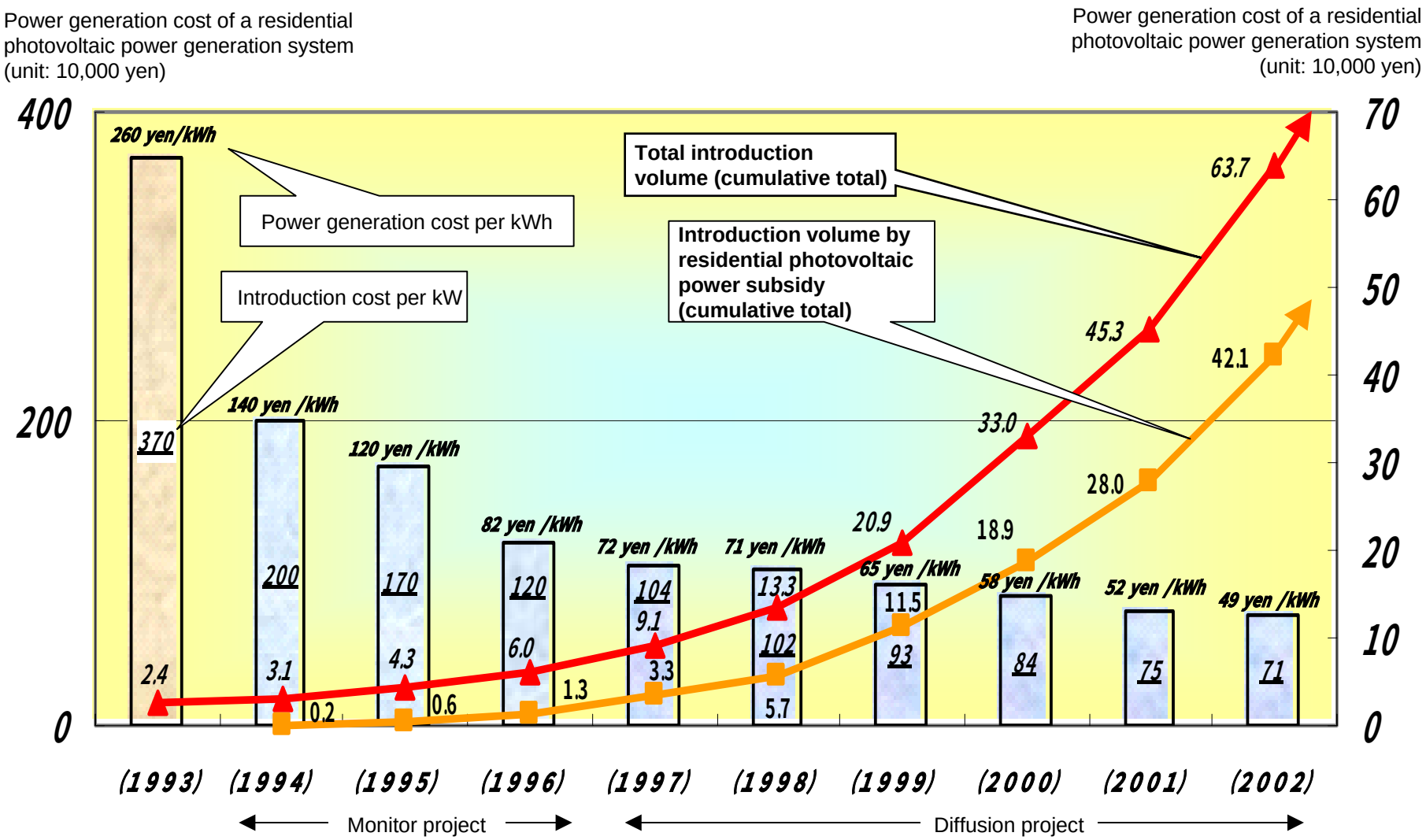
* Inverter: Converts generated D.C. power to A.C. power
* Metering device: Calculates power purchased from and power sold to an electric company.

For 3.5 kW equipment

- Necessary site area: 35m^2
- Electricity generated: about 3,680 kWh/year
  Trial calculation formula:
  3,680 kWh/year = 3.5kW x (24h x 365D) x use rate 12%
- Electricity consumed by a general household: about 3,600 kWh per year
- Durability: about 20 years
  * Legal durability: 15 years
- Cost: About 2.5 million yen including construction fee (FY2002)

(Remarks)
- The size of electricity equipment (kW) corresponds to the size of the diameter of a water pipe.
- The electricity generated (kWh) corresponds to the volume of water from a water pipe.

Change in Introduction Volume, Price, and Power Generation Cost of a Residential Photovoltaic Power Generation System



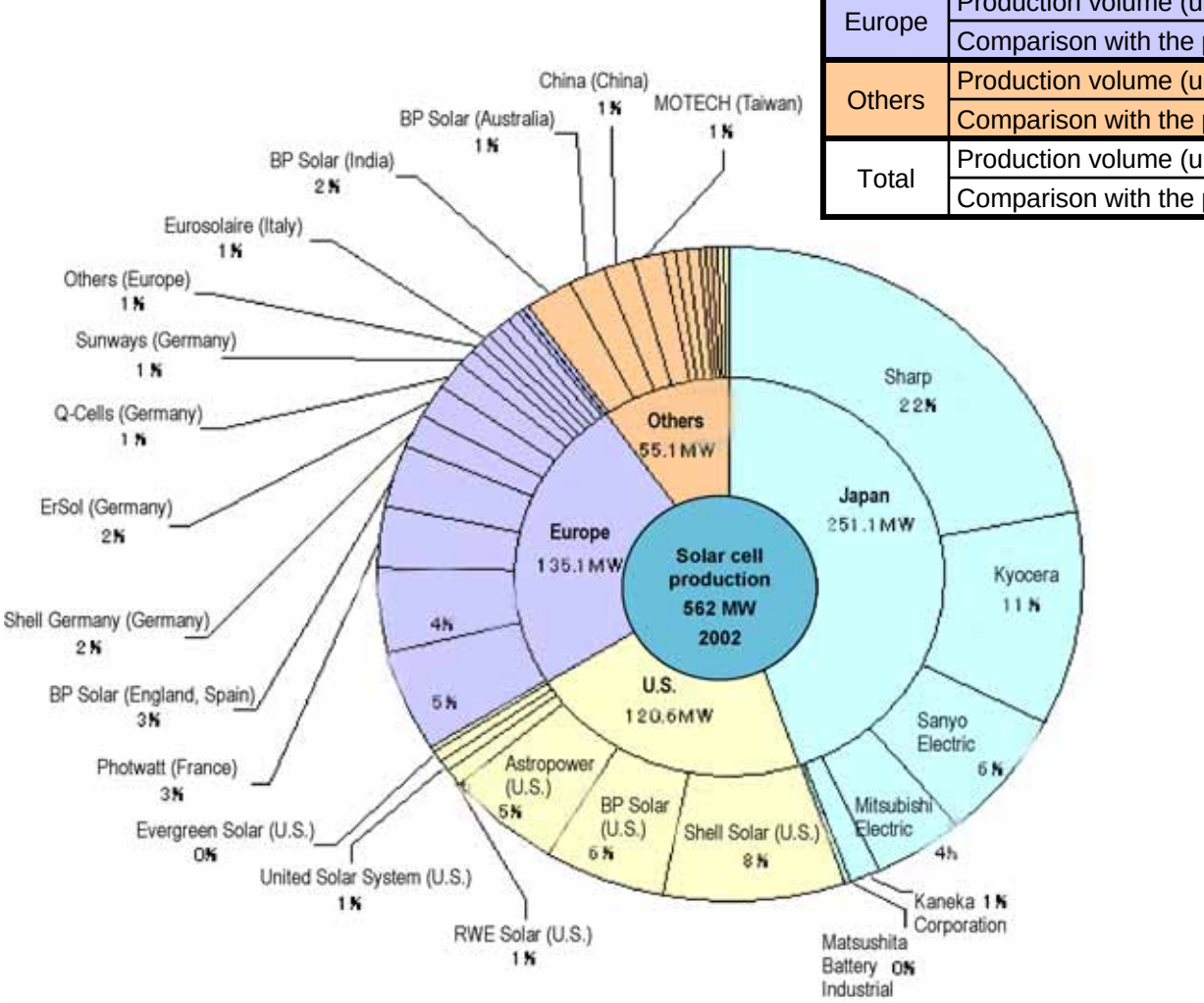
Source: Trial calculation by the Ministry of Economy, Trade and Industry, based on discussion with the maker, etc.

Solar Cell Production Shares by Nation / Region and by Enterprises in 2002

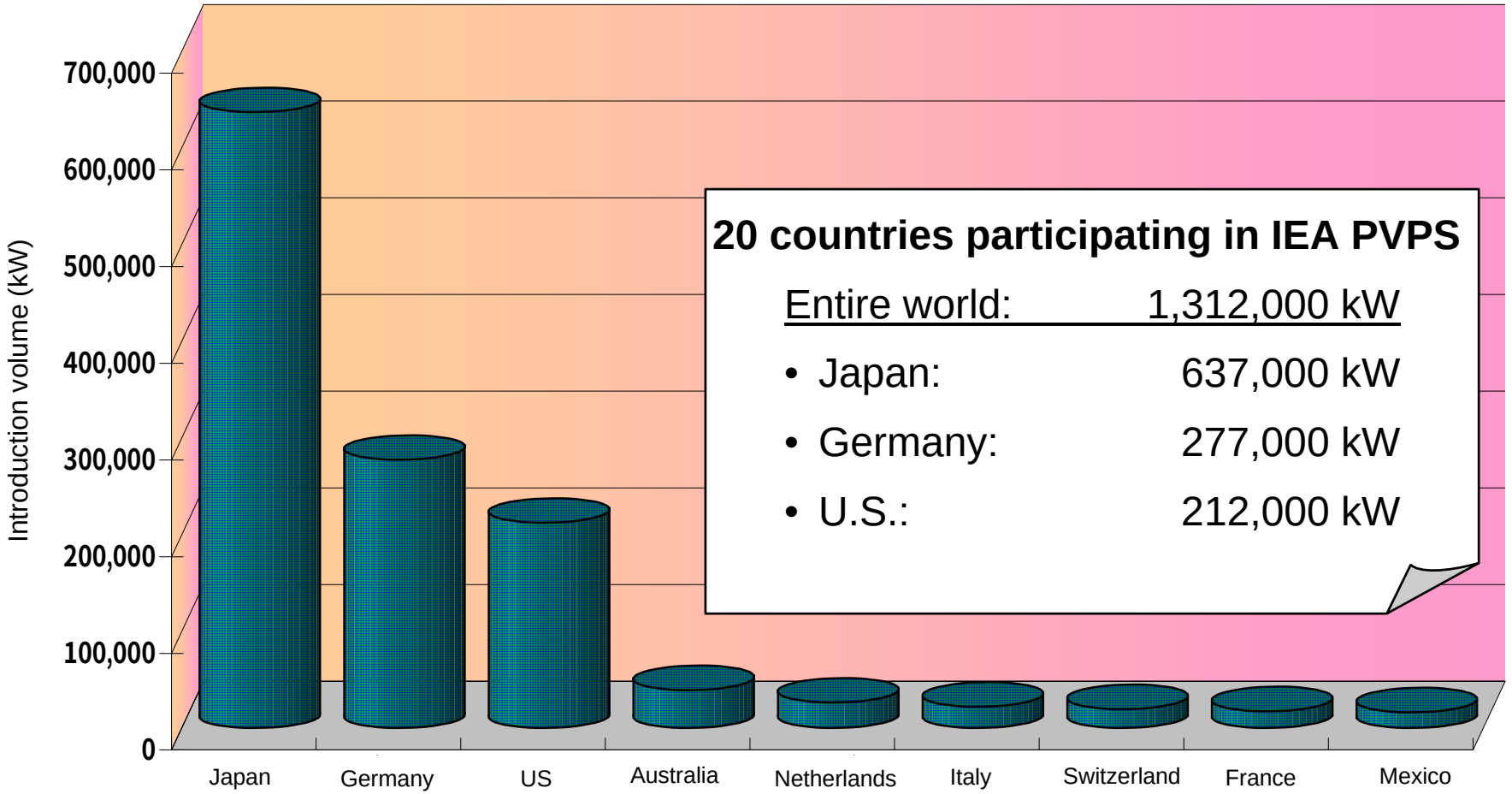
Solar cell production volume by region

PV NEWS

		1998	1999	2000	2001	2002
U.S.	Production volume (unit: 10,000 kW)	5.4	6.1	7.5	10.0	12.1
	Comparison with the previous year (%)	105.3	113.2	123.3	133.8	120.2
Japan	Production volume (unit: 10,000 kW)	4.9	8.0	13.0	17.1	25.1
	Comparison with the previous year (%)	140.0	163.3	162.0	132.1	146.6
Europe	Production volume (unit: 10,000 kW)	3.4	4.0	6.1	8.6	13.5
	Comparison with the previous year (%)	110.2	119.4	151.7	142.4	156.3
Others	Production volume (unit: 10,000 kW)	1.9	2.1	2.3	3.3	5.5
	Comparison with the previous year (%)	198.9	109.6	114.2	139.3	168.8
Total	Production volume (unit: 10,000 kW)	15.5	20.1	28.9	39.1	56.2
	Comparison with the previous year (%)	123.1	130.0	143.4	135.3	143.8



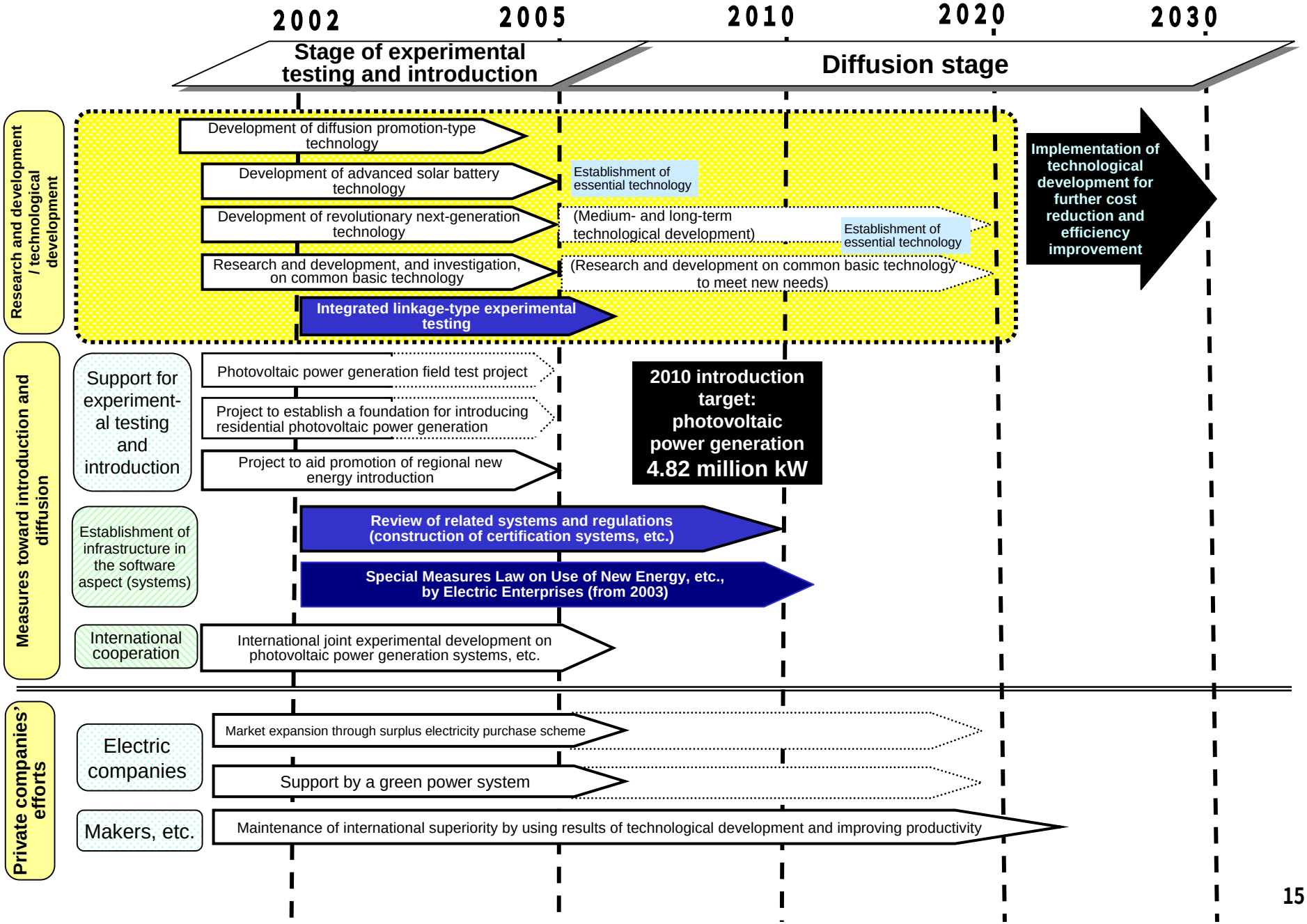
Photovoltaic Power Generation Introduction Volume in 2002 (International Comparison)



Australia, Austria, Canada, Switzerland, Denmark, Germany, Finland, France, England, Israel, Italy, Japan, South Korea, Mexico, Holland, Norway, Portugal, Sweden, U.S., Spain (Spain is excluded from the total volume due to absence of updated data.)

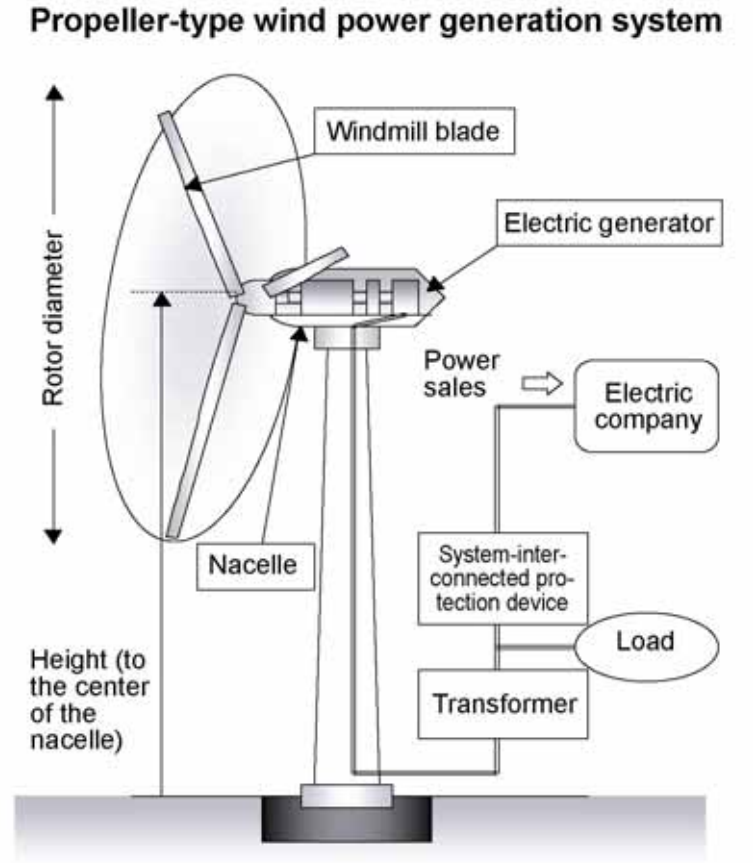
Source: Trends in Photovoltaic Applications / IEA / PVPS (as of 2002)

Scenario on Introduction and Expansion of Photovoltaic Power Generation



What is Wind Power Generation?

The method of generating power by rotating windmills,
and conveying the rotational movement to power generators.



In the case of 1,000 kW equipment

(Rotor diameter: D=56 m, height (to the center of nacelle): 60 m)

- Necessary site area: about 50,000 m^2
- Electricity generated:
  about 1.75 million kWh/year

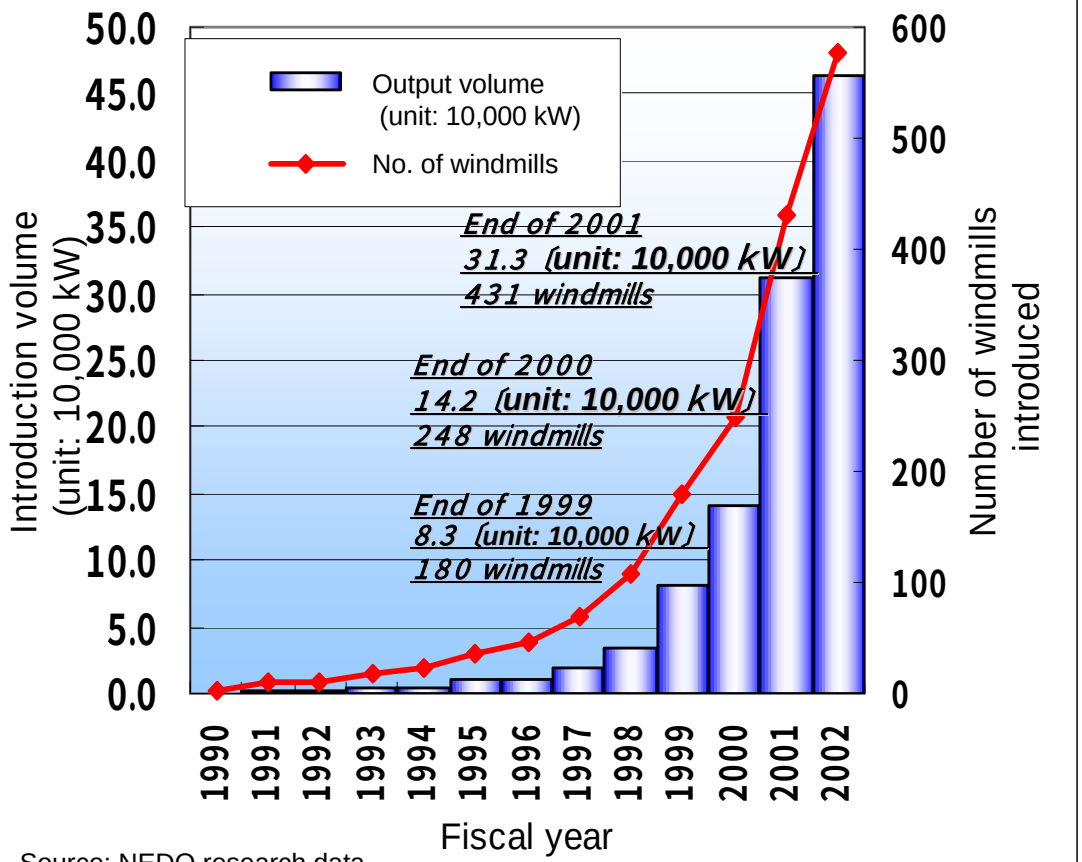
  Trial calculation formula:
  1,750,000 kWh/year = 1,000 kW x (24h x 365D) x use rate 20%

  (For about 486 general households)
- Durability: 17 years (legal durability)
- Cost: About 200 to 300 million yen,
  including construction fee (FY2000)

Change in Wind Power Generation Introduction Volume in Japan

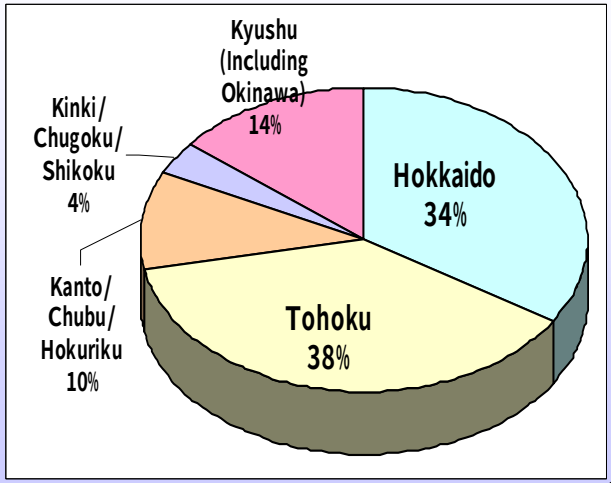
End of FY2002
46.3 (unit: 10,000 kW)
576 windmills

Actual introduction record



Source: NEDO research data

Introduction state by region (end of FY2002)

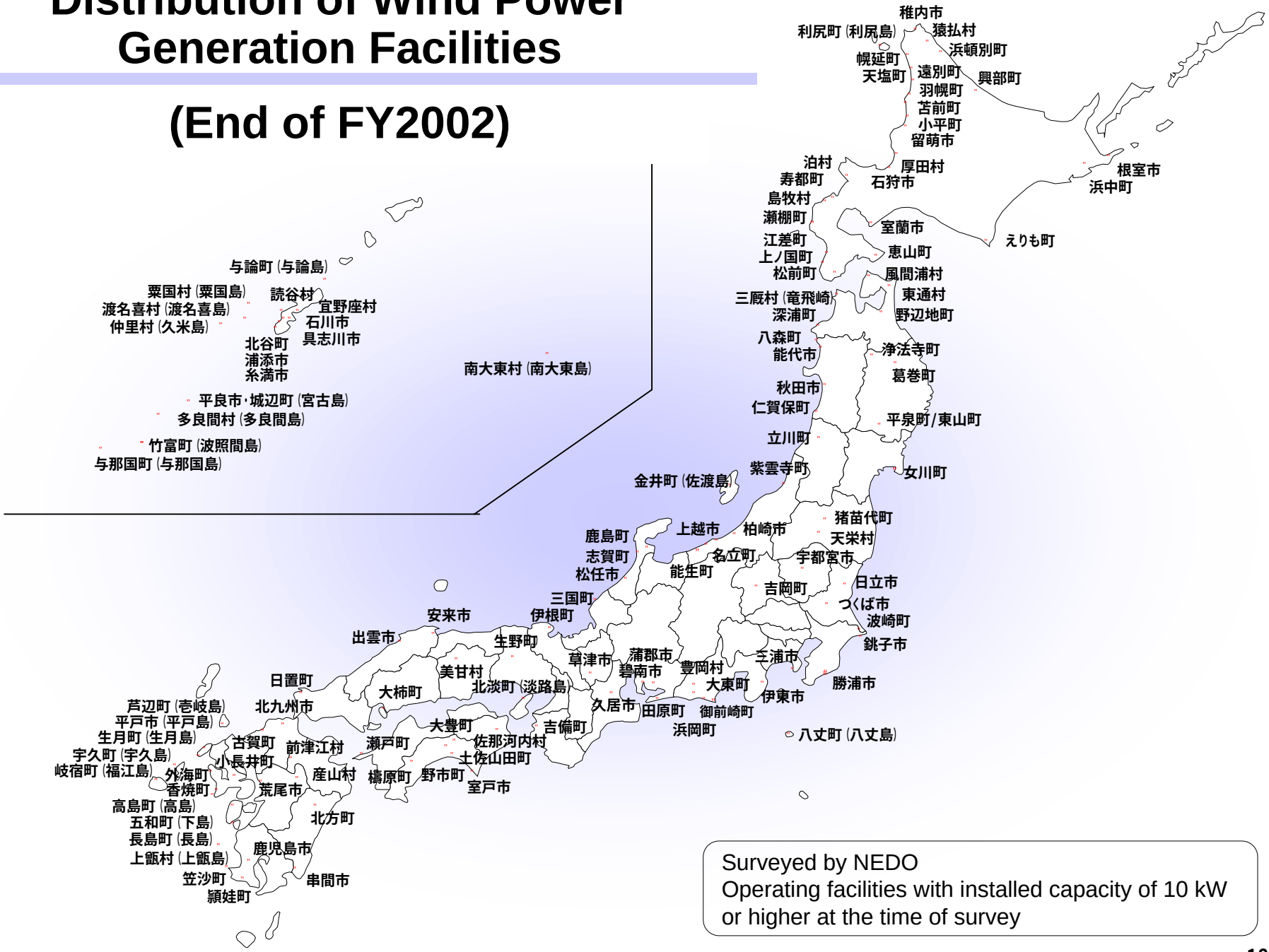


Prefectures with high introduction volumes (end of FY2002)

Hokkaido	156,000 kW
Aomori Pref.	102,000 kW
Akita Pref.	61,000 kW
Kagoshima Pref.	19,000 kW
Mie Pref.	17,000 kW
Fukuoka Pref.	15,000 kW
Nagasaki Pref.	14,000 kW
Okinawa Pref.	14,000 kW
Niigata Pref.	7,000 kW
Yamagata Pref.	7,000 kW

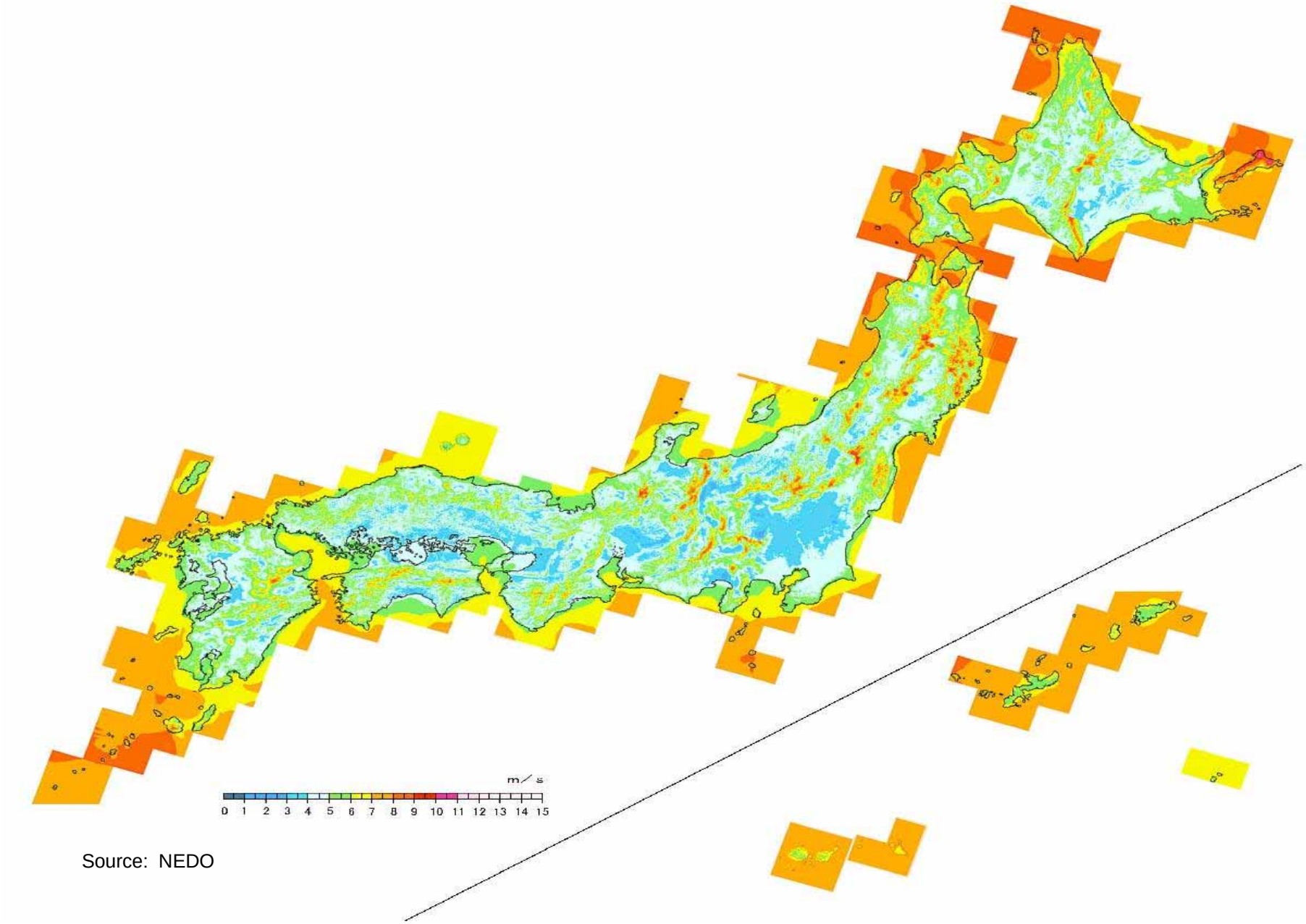
Distribution of Wind Power Generation Facilities

(End of FY2002)



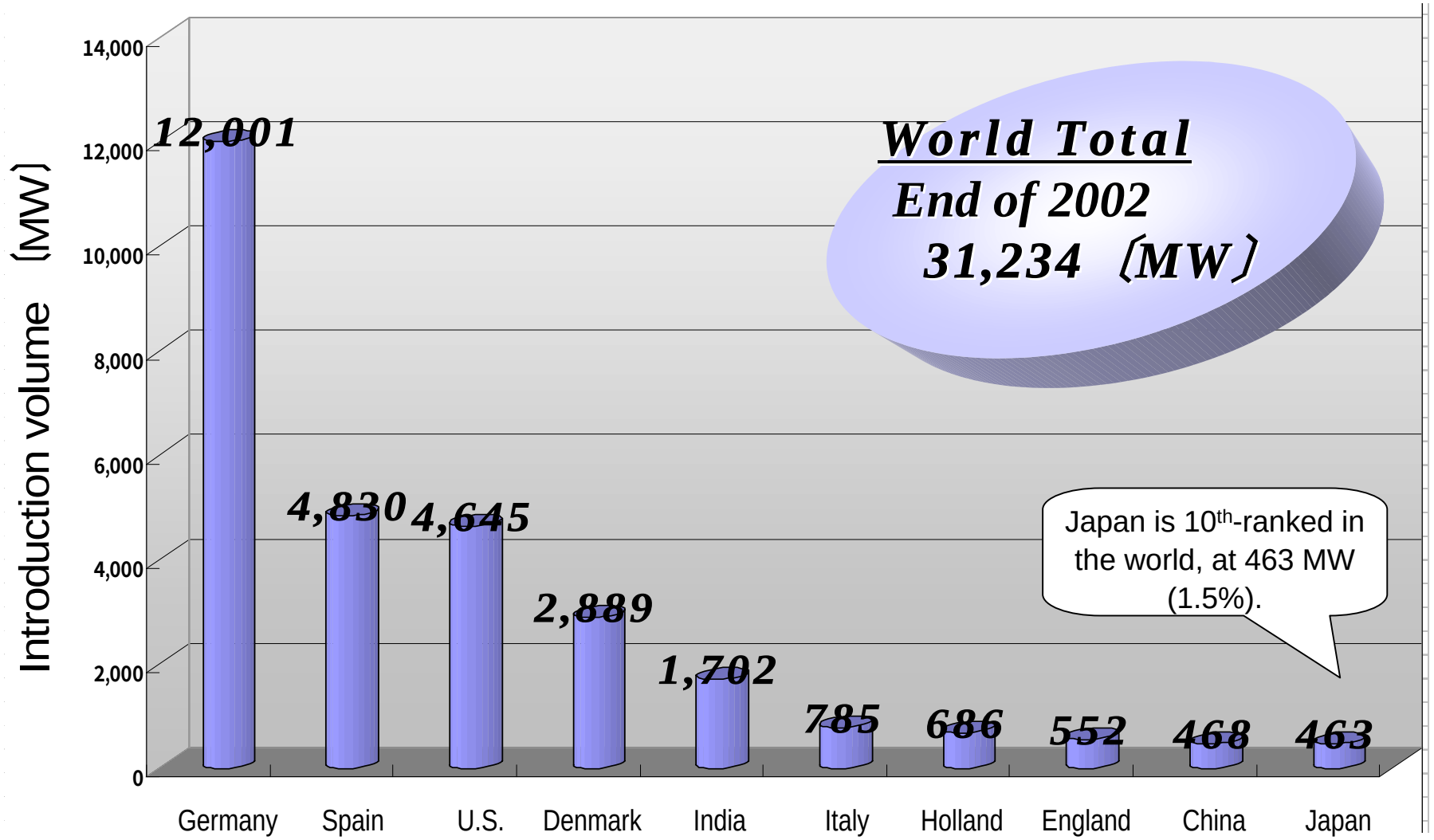
Surveyed by NEDO
Operating facilities with installed capacity of 10 kW or higher at the time of survey

National Wind Condition Map



Source: NEDO

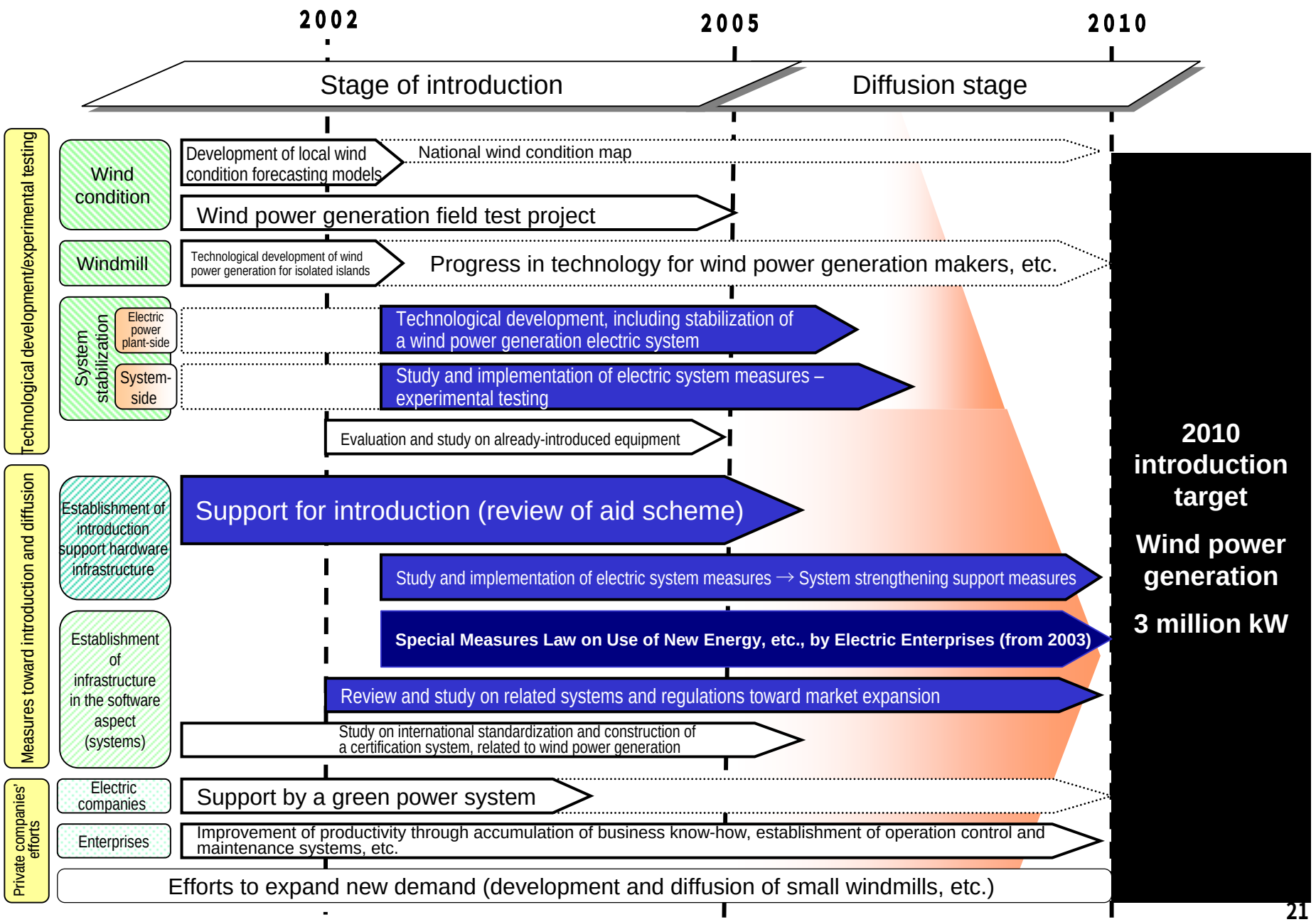
International Comparison 《 State of Introduction in Various Countries 》



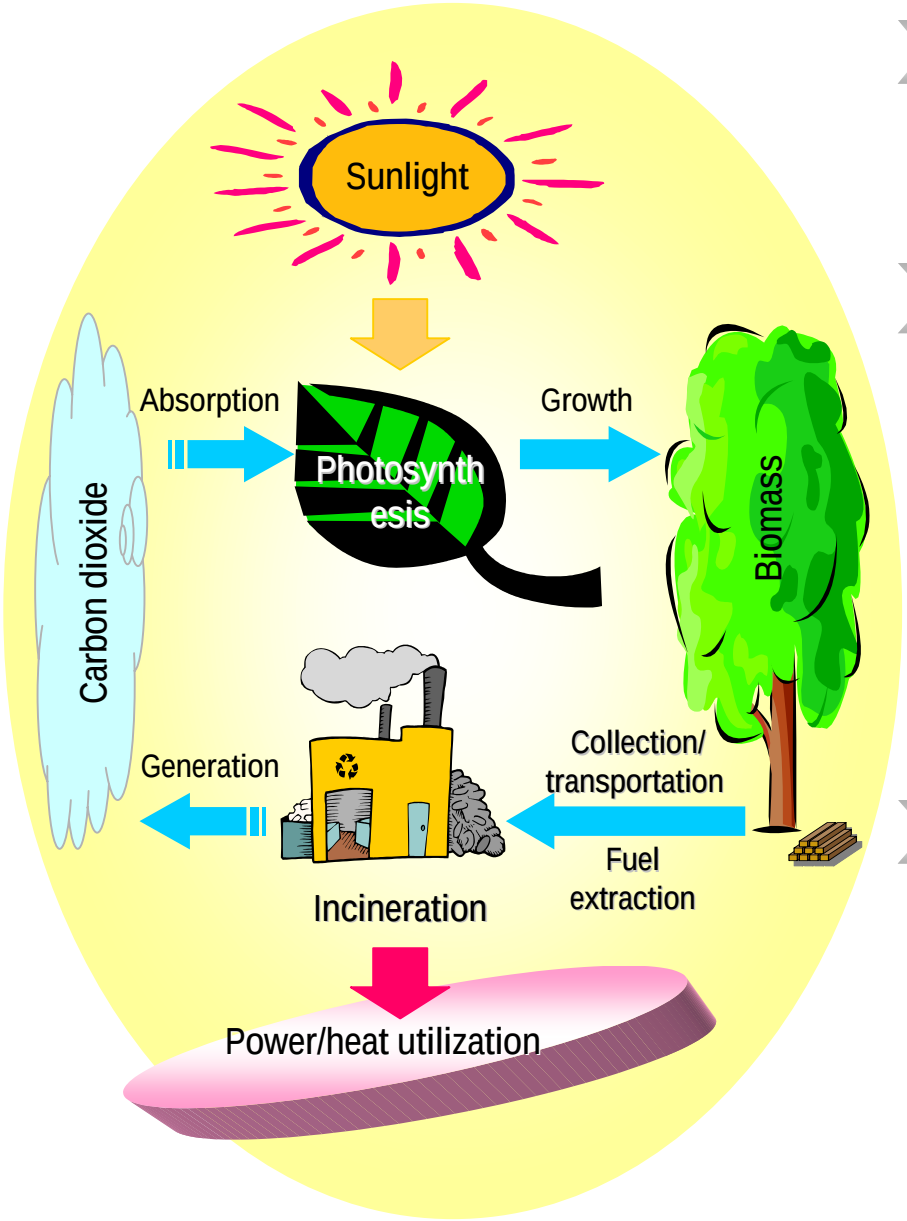
Note 1: Source: Wind Power Monthly (presenting nations with 100 MW or more as of the end of 2002)

Note 2: Volume as of the end of FY2002 for Japan (surveyed by NEDO) [MW = 1,000 kW]

Scenario on Introduction and Expansion of Wind Power Generation



What is Biomass Energy?



What is biomass?

Organic matter from animals and plants, except for fossil resources, that is usable as energy source

Significance as energy

(1) Biomass is carbon-neutral renewable energy, and additional CO_2 will not be emitted if the balance of discharge of CO_2 is considered through fixed CO_2 use, by fostering biomass at the same time with utilization.

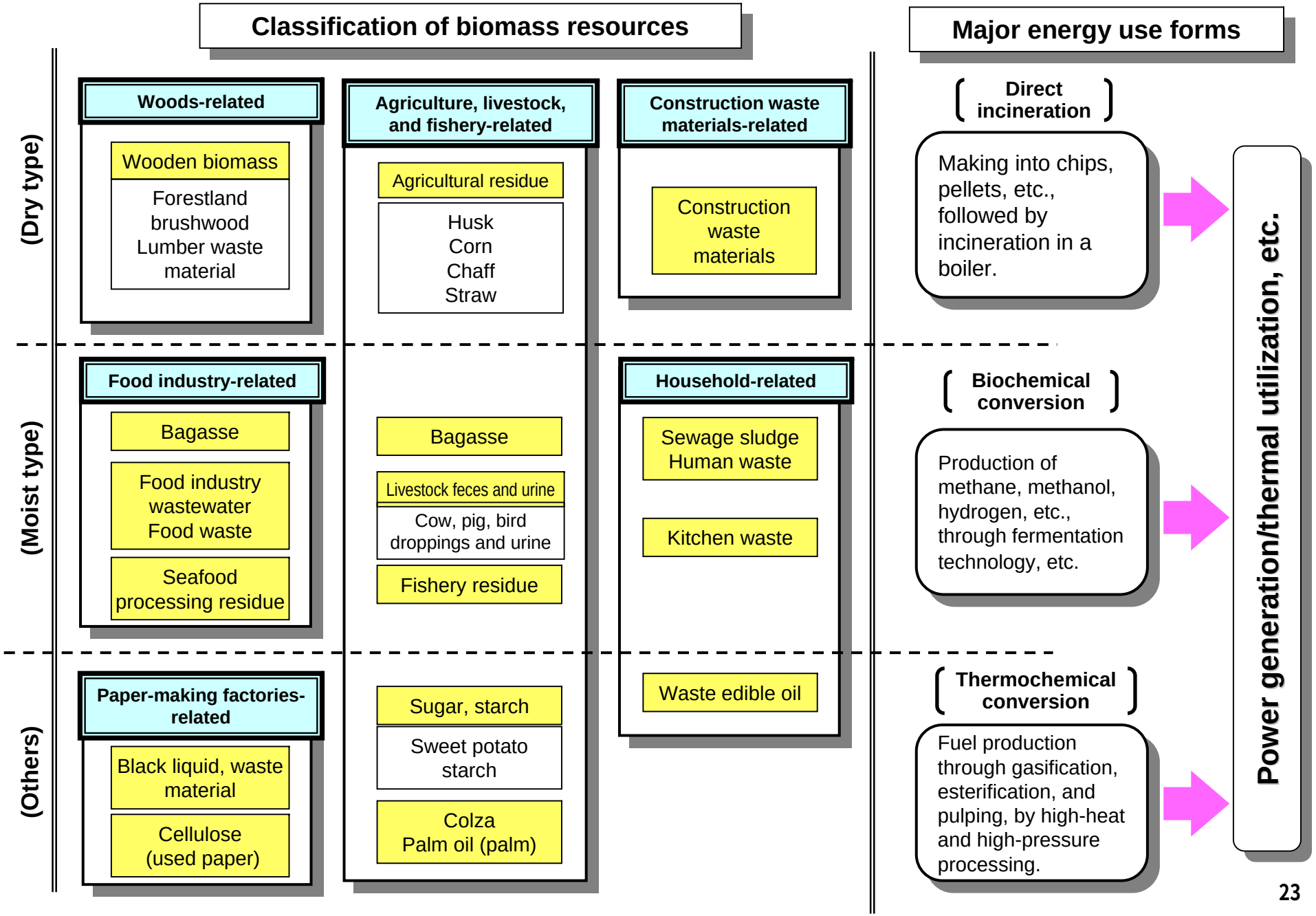
(2) Diversification of energy sources can be promoted by newly using biomass, which has never been used.

Problems to conquer

(1) Its generation distribution is wide and thin, and the energy density per capacity is low, resulting in a great load for resource collection and transportation.

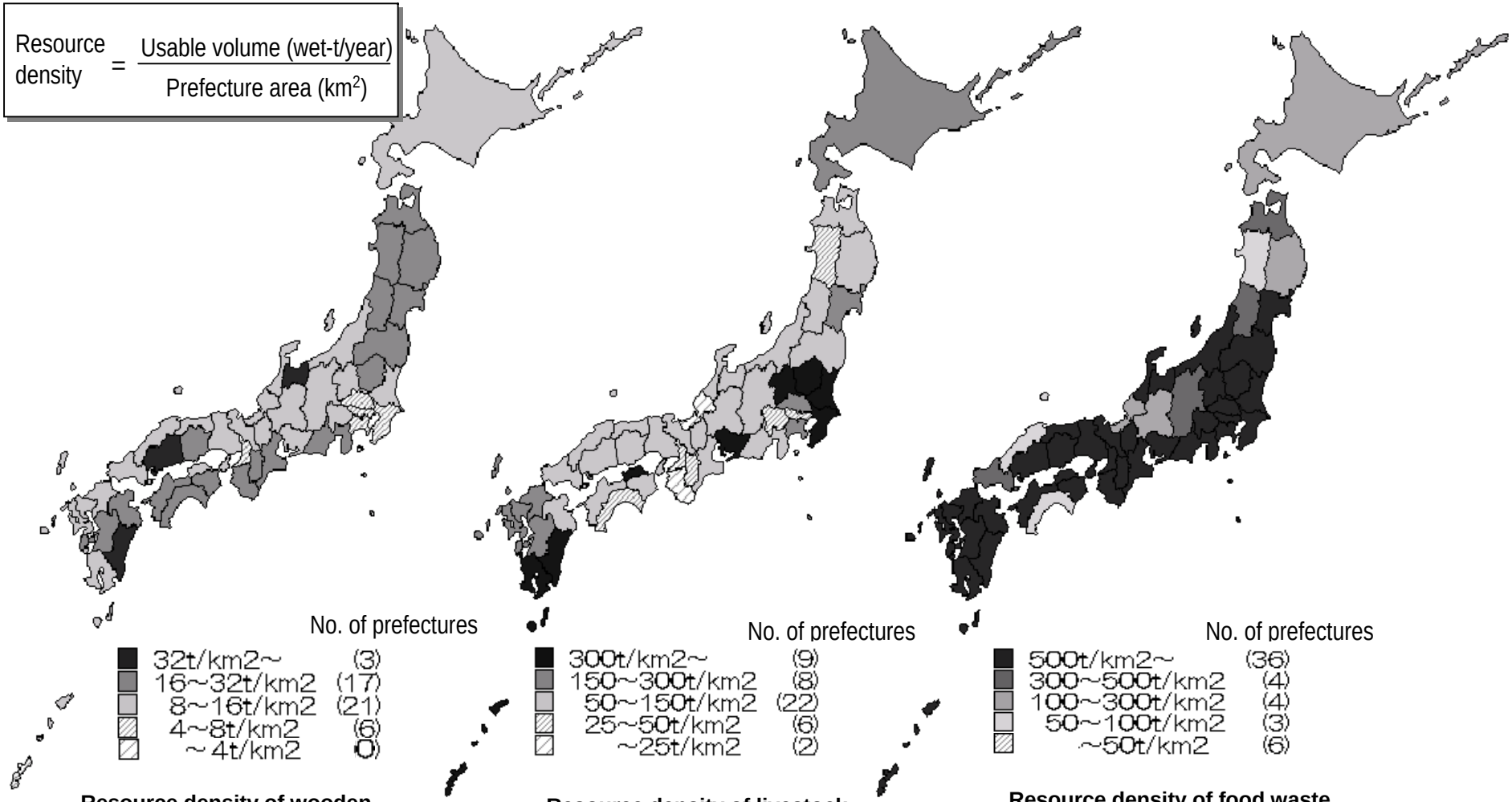
(2) Facilities tend to be of small scale and dispersed, and it is difficult to enhance efficiency and reduce cost through scale merit.

Types and Usages of Biomass Resources



Density of Generation of Major Biomass Resources

Resource density = Usable volume (wet-t/year) / Prefecture area (km^2)



Resource density of wooden biomass (thinned wood, forestland brushwood, lumber waste material)

Resource density of livestock excreta biomass (milk cows, beef cows, pigs, layer chickens)

Resource density of food waste biomass (food processing waste, food sales waste))

Assuming that the resource collection range is within 50 km for wooden biomass, and within 20 km for others, and assuming collection of 50% of usable volume, prefectures with resource density to enable collection of resources of 100 t/d (300-day operation) or more, which is generally said to be the minimum necessary scale for business, are shown by □～■ in the map.

Example of Facilities Using Biomass: No. 1

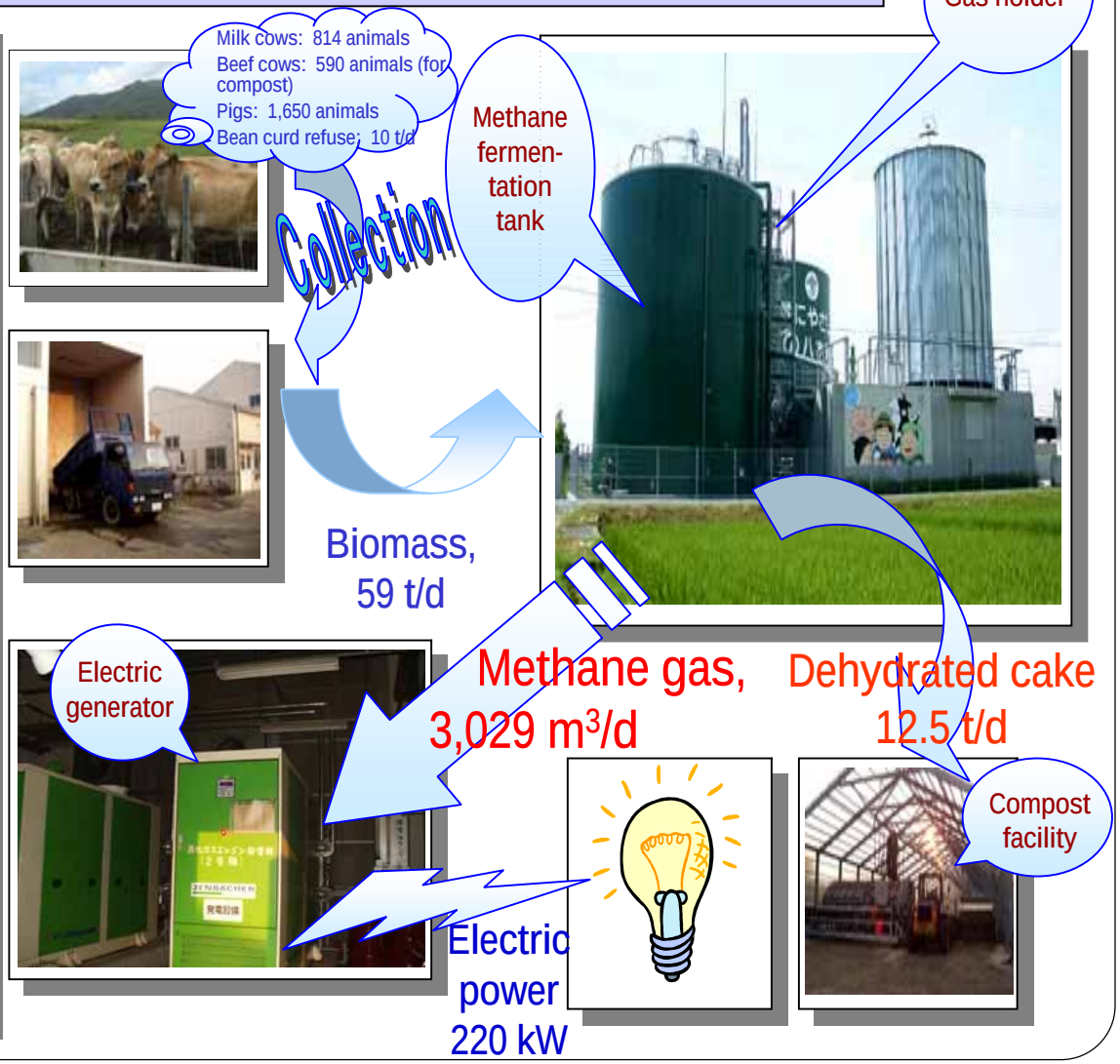
Wooden biomass power generating facility (direct incineration),
– Noshiro city, Akita prefecture

[Entity that established the facility]
Noshiro Forest Resource Use Association
[Biomass]
Japanese cedar bark / waste material, etc.
54,360 t/year
[Total business cost]
1,460 million yen
[Outline]
Established by investment by lumber businesses, forestry cooperatives, and waste businesses, aiming to reduce the disposal cost for Japanese cedar bark, etc., which become industrial waste.
Sells electricity and steam to the adjoining board factory.

Example of Facilities Using Biomass: No. 2

Livestock excreta methane fermentation facility (methane gas power generation) – Yagi town, Kyoto prefecture

[Entity that established the facility]
Yagi town, Kyoto prefecture
(Yagi Bio Ecology Center)
[Biomass]
Cow manure, pig manure, bean curd refuse
19,461 t/year
[Total business cost]
1,723 million yen (including compost facility)
[Outline]
Conducts power generation using gas generated from livestock excreta, etc., and uses cooling water from the electric generator for heating and hot water supply. Makes compost from processed excreta, for use for agricultural land.



Support toward Biomass Energy Introduction

General introduction flow

Regional needs / purposes of new energy introduction
- Stable energy supply
- Contribution to prevention of global warming, etc.
- Promotion of the region, etc.

Establishment of a regional new energy plan
- Grasping and analysis of regional characteristics
- Establishment of individual project plans, etc.

Technology development for cost reduction and efficiency enhancement

Study on business introduction and business establishment
- Introduction plan - Study on financial resources
- Business method - Experimental testing, etc.

Judgment on business establishment

Adjustment with related agencies, establishment of an implementation plan, designing
Installation construction

Start of use of service

Main support system

Support

Activities, such as establishment of regional new energy visions (for local public bodies)

To provide subsidy for activity cost to local public bodies that conduct the below-mentioned activities, aiming to establish a plan to give new impetus to improving the region's energy in the 21st century, by such as bringing out regional latent diversified energy, and finding a creative direction to establish a community in harmony with the environment.

(Subsidy: fixed amount)

2003 budget: 1,320 million yen → 2004 budget plan: 1,180 million yen

Support

Technology development for biomass energy high-efficiency conversion

To provide subsidy for technology development cost to private enterprises, etc., that conduct technology development to highly efficiently convert biomass resources into useful energy, such as gas fuel and liquid fuel, jointly with the New Energy and Industrial Technology Development Organization (NEDO).

(Subsidy: fixed amount; 1/2, in principle, for development of core technology)

2003 budget: 2;820 million yen → 2004 budget plan: 3;840 million yen

Support

Experimental testing / business research on unused energy, such as biomass

To provide subsidy for part of business cost, to local public bodies and enterprises that conduct experimental test business, business feasibility research, etc., aiming to effectively use, as energy, unused resources existing in the region, such as biomass, that do not burden the environment.

2003 budget: 2,820 million yen → 2004 budget plan: 2,850 million yen

- Subsidy for experimental test business: 1/2 or less
- Subsidy for experimental test business research: fixed amount (by NEDO: subsidy up to 10 million yen/case)
- Subsidy for business feasibility research: fixed amount (by a bureau of economy, trade and industry, etc.: subsidy up to about 10 million yen/case)

* The maximum amount varies depending on the implementing bureau.

Support

Activities to promote regional new energy introduction (subsidy: 1/2 or less)

To provide subsidy for part of business cost, to local public bodies, etc., that conduct model-like and advanced efforts, such as large-scale, intensive introduction of new energy, in the region.

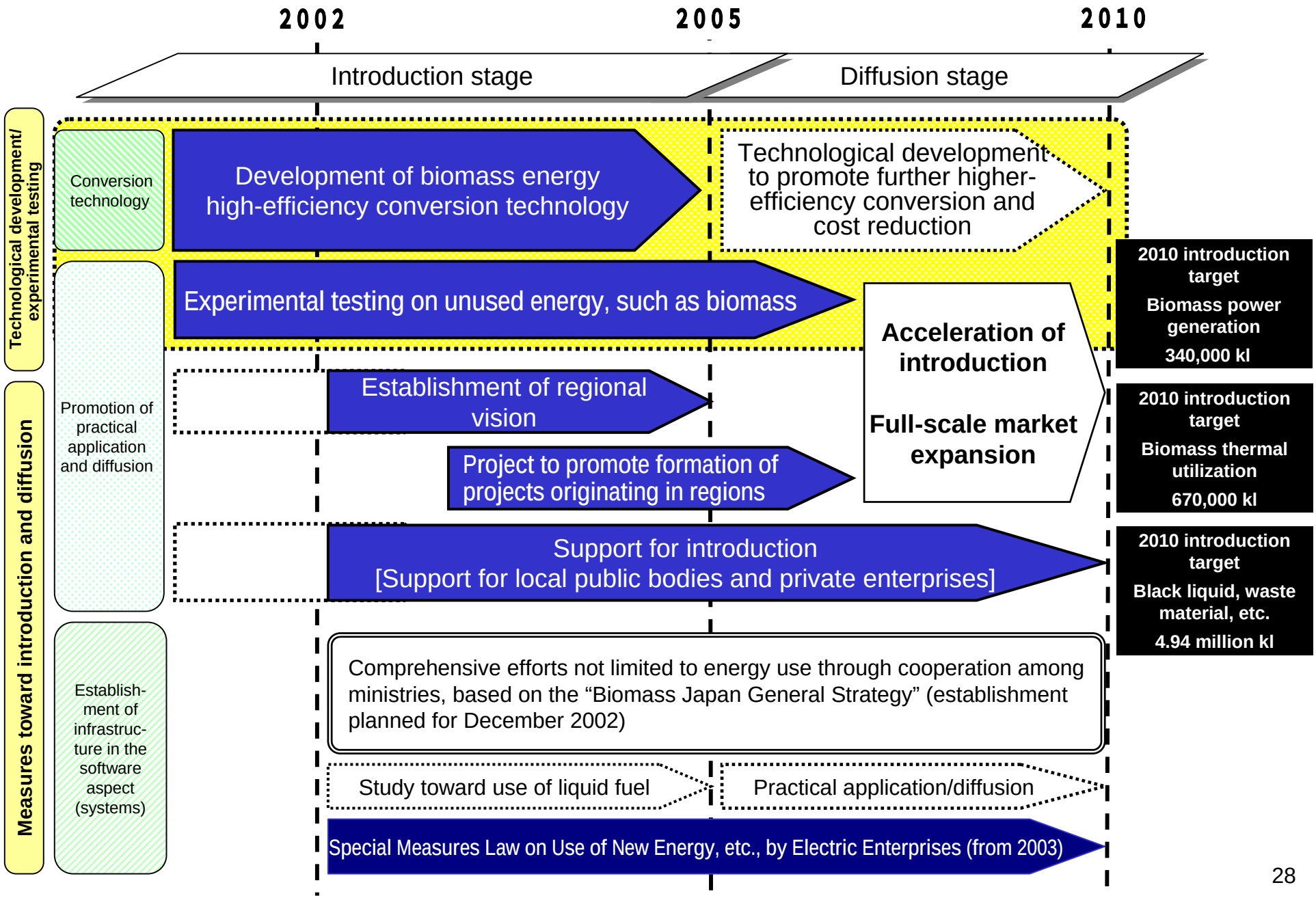
2003 budget: 12,710 million yen → 2004 budget plan: 11,130 million yen

New energy enterprise support measures (subsidy: 1/3 or less)

To provide subsidy for part of business cost, to advanced enterprises that introduce new energy according to the plan approved based on the New Energy Act.

2003 budget: 38,820 million yen → 2004 budget plan: 48,260 million yen

Scenario on Introduction and Expansion of Biomass Energy



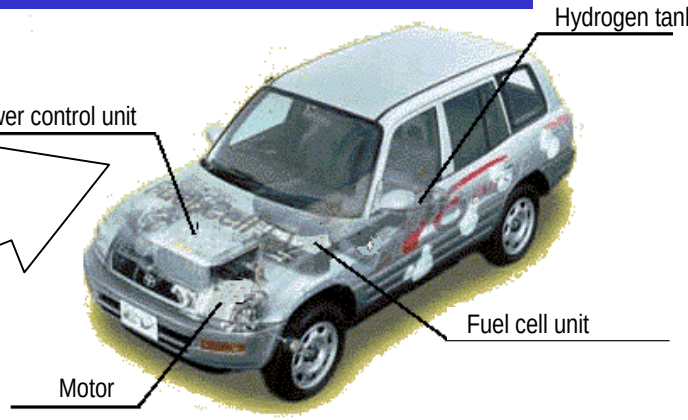
What is a Fuel Cell?

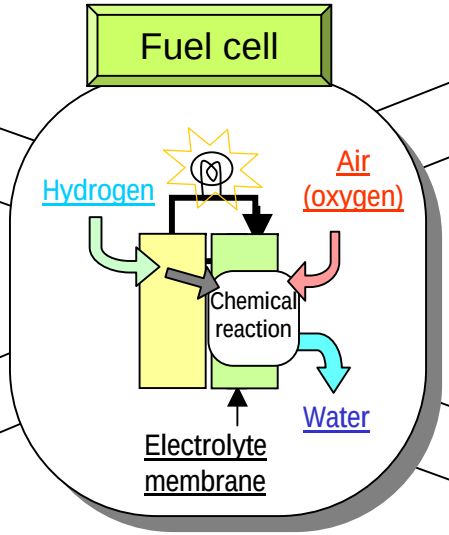
Stationary fuel cell

Household distributed energy

Fuel cell-powered vehicle

Environmentally friendly ultimate vehicle





Portable fuel cell

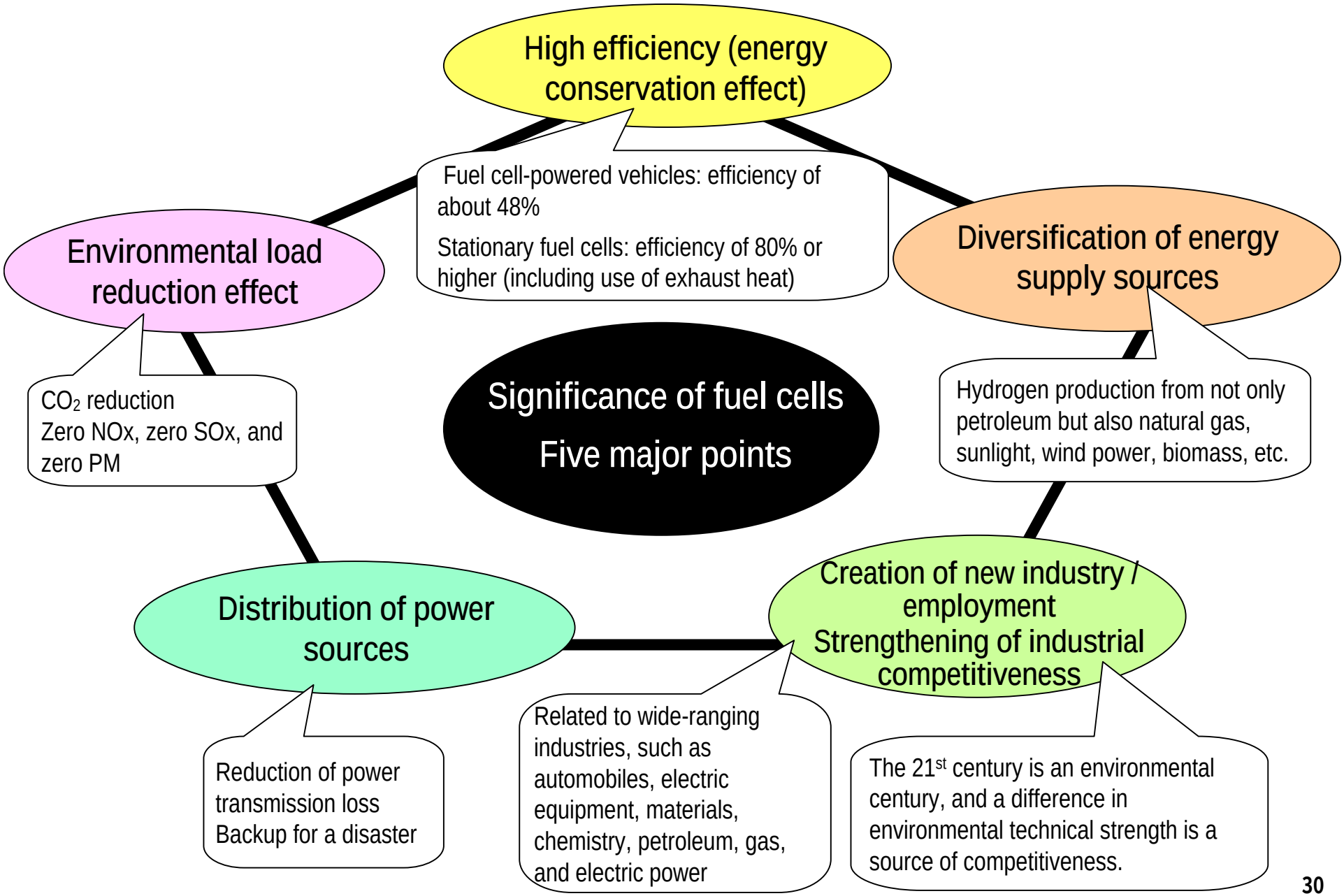
Long-lasting innovative power source

High-temperature fuel cell

Innovative energy source with high power generation efficiency, for business establishments

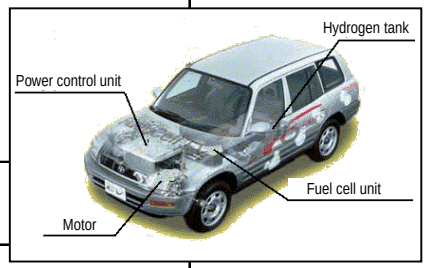
- Handling of environmental problems
- Securing of energy security
- Creation of new industry

Significance of Fuel Cells



Trend of Development of Fuel Cell-Powered Vehicles

	2002	2003	2004～
Government efforts	Experimental testing by the Ministry of Economy, Trade and Industry - Establishment of hydrogen stations each using one of ten different types of fuels - Experimental operation of fuel cell-powered passenger cars and buses ・Initiated introduction of fuel cell-powered vehicles		・Implementation of re-inspection of regulation
Toyota	○FCHV-BUS2development (Sep.) ●FCHV trial sales (Dec.) Participation in experimental research	Start of the FCHV-BUS2 metropolitan bus experimental testing (Aug.) 03 Planned to sell 20 vehicles for Japan and the U.S., combined	
Honda	●Honda FCXtrial sales (Dec.) Participation in experimental research	02～03 Planned to lease sales of 30 vehicles for Japan and the U.S., combined	
Nissan	○OX-TRAIL FCV development (Dec.) Participation in experimental research	Announcement of trial sales at the end of 2003	
Mitsubishi		○Mitsubishi FCV development (Sep.) Planned to participate in experimental research	
Suzuki		○Development of wagon R-FCV, MR wagon- FCV (Oct.) Planned to participate in experimental research	
Daihatsu	○MOVE FCV K-2 development (2001)	Start of experimental testing with Osaka prefecture, etc.	
Mazda	○PREMACY FC-FV development (2001)		
Fuji Heavy Industries	○SAMBAR FCEV (2000)		
General Motors	Participation in experimental research	○Hydoro Gen3 approved in Japan	Sales of several tens of thousands of vehicles / year (2010)
Daimler Chrysler	Participation in experimental research	○F-Cell approved in Japan Start of experimental research on buses in Europe Planned to start sales of fuel cell-powered buses and passenger cars	
Ford		Planned to start trial sales from 2002 to 2003	



Trend of Development of Stationary Fuel Cells

	2002	2003	2004	
Government efforts	Experimental testing by the Ministry of Economy, Trade and Industry Start of testing at 12 places	Start of testing at 31 places		
Matsushita Electric Industrial	Participation in experimental testing →			●Commercialization of 1 kW cogeneration products (2004)
Sanyo Electric	Participation in experimental testing →			●Start of trial sales of 1 kW (2004) ●Full-scale sales of 1 kW (2005)
Mitsubishi Heavy Industries		Participation in experimental testing →		●Start of sample shipment (2004) ●Market introduction of 1 kW (2005)
Toshiba International Fuel Cells	Participation in experimental testing →			●Start of practical application of 1 kW and 5 kW (2004 to 2005)
Ebara Corporation Ebara Ballard	Participation in experimental testing →			●Sales of hydrogen bomb-type 1kW class (2003) ●Commercialization of 1 kW (2004)
Nippon Oil Corporation	Participation in experimental testing →			●Practical application of 1 kW (2004)
Toyota Motor Corporation	Participation in experimental testing →			●Planned to establish business (2004) ●Sales with model homes (2008)
Hitachi, Ltd.		Participation in experimental testing →		●Practical application of 1 kW (2004)
Tokyo Gas				●Practical application of 1 kW (2004)
Osaka Gas				●Commercialization of 0.5 to 1 kW (2005)
Plug Power				●Start of sales of 5 kW (2004)
Ballard Generetion System				●Sales of hydrogen bomb-type 1 kW class (2003)

Outline on the Fuel Cell Technology Development-Related Budget for FY2004

The Government budget plan for FY2004 is ¥32.9 billion
(FY2003 budget: ¥30.7 billion)

【Main budgets】

(1) Technology development for polymer electrolyte fuel cell systems (¥5,110 million → 4,150 million)
Development of respective core technologies, materials technology, etc., of fuel cells; development of technologies for systematization, mass production, cost reduction, etc.

(2) Basic technology development for safe hydrogen use, etc. (¥4,550 million → 6,350 million)
Establishment of safety technology, including acquisition of data necessary to verify hydrogen safety, and development of related equipment, such as compressors, necessary for hydrogen fuel infrastructure

(3) Research, such as experimentation on polymer electrolyte fuel cell systems (¥3,860 million → 3,000 million)
Public road driving testing of fuel cell-powered vehicles, including experimentation on fuel supply stations; operation testing of stationary fuel cell cogeneration systems under actual use conditions, etc.

(4) Establishment of a foundation to diffuse polymer electrolyte fuel cell systems (¥3,870 million → 2,400 million)
Collection of various data through evaluation testing, establishment of an evaluation test method, suggestion of a criteria / standards plan, etc. (millennium project)

(5) Technology development for lithium cells for fuel cell-powered vehicles (¥1,950 million → 1,980 million)
Development of long-lasting, high-output lithium cells with the highest energy efficiency among accumulator batteries

(6) Technology development for portable fuel cells (¥220 million → 780 million)
Technology development aimed at practical application of portable fuel cells several years in the future, technology development related to criteria / standards

(7) Technology development for solid oxide fuel cell systems **(new)** (¥0 → 1,600 million)
Research and development, and experimental research, aimed at practical application of solid oxide fuel cell cogeneration systems

Fuel Cell-Powered Vehicles and Infrastructure Experimental Testing

Implementation system (FY2003)

Ministry of Economy, Trade and Industry

[Aid] Related to experimentation on fuel cell-powered vehicles

Japan Automobile Research Institute

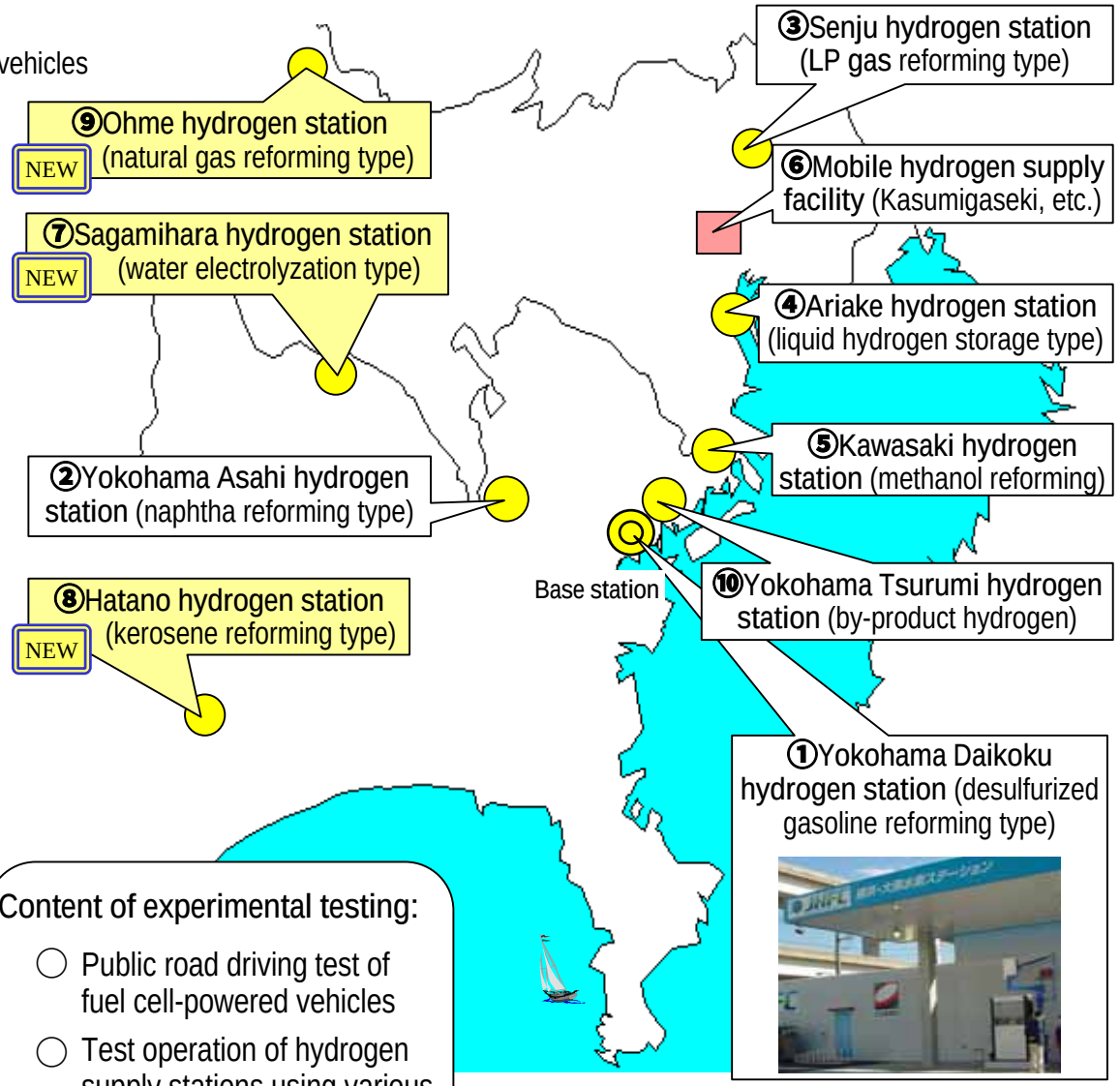
- General Motors
- DaimlerChrysler
- Toyota Motor
- Nissan Motor
- Honda Motor
- Japan Automobile Research Institute
- New Suzuki
- New Hino Motors
- New Mitsubishi Motors

Related to experimentation on hydrogen supply infrastructure

Engineering Advancement Association of Japan

- (1) Cosmo Oil
- (2) Nippon Oil
- (3) Tokyo Gas
  Nippon Sanso
- (4) Showa Shell Sekiyu
  Iwatani International
- (5) Japan Air Gases
- (6) Nippon Sanso
- New (7) Kurita Water Industries
  Sinanen
  Itochu Enex
- New (8) Idemitsu Kosan
- New (9) Babcock-Hitachi
- (10) Tsurumi Soda
  Nippon Steel

State of establishment of hydrogen stations



Content of experimental testing:

- ○ Public road driving test of fuel cell-powered vehicles
- ○ Test operation of hydrogen supply stations using various materials and fuels

Experimental Research on Stationary Fuel Cells

FY2002	FY2003	FY2004
Operation at 12 places nationwide		
	Operation at 31 places nationwide	

Ministry of Economy, Trade and Industry

[Aid]

New Energy Foundation

State of establishment (Osaka)

State of establishment (Nagoya)

＜Establishing / operation testing organizations＞

The Japan Gas Association (JGA): 10 sites
Tokyo Electric Power Company, Inc.
Hokkaido Electric Power Company, Inc.
Hokuriku Electric Power Company, Inc.
Kansai Electric Power Company, Inc.
Chugoku Electric Power Company, Inc.
Kyushu Electric Power Company, Inc.
Kandenko
YURTEC Corporation
Idemitsu Kosan Co., Ltd.
Japan Energy Corporation
Taiyo Oil Co., Ltd.
SINANEN Co., Ltd.
Sekisui Chemical Co., Ltd.
Ebara Corporation
NTT DATA
Tokiwa Shoji
Matumura Bussan Co., Ltd.
Association for Research and Development of House Technology Creating Life Value
Niigata Prefecture
Gifu Prefecture
Muroran Advancement Center of Industrial Technology and Management

＜System suppliers＞

Ishikawajima-Harima Heavy Industries Co., Ltd.
Ebara Corporation
Kurita Water Industries Ltd.
SANYO Electric Co., Ltd.
Nippon Oil Corporation
Toshiba International Fuel Cells Corporation
Toyota Motor Corporation
Hitachi Home & Life Solutions, Inc.
Marubeni Corporation
Matsushita Electric Industrial Co., Ltd.
Mitsubishi Heavy Industries, Ltd.

Content of experimental testing	○Test operation of fuel cell cogeneration systems in various environments ○Evaluation testing on influence of household fuel cells at system linkage

Re-inspection of Regulation on Practical Application of Fuel Cells

○Liaison conference of related government agencies regarding practical application of fuel cells

The items the industrial world had requested to be studied (28 items of six laws *1) were studied on the premise of securing safety; and, schedule, etc., were arranged, in the "liaison conference of related government agencies regarding practical application of fuel cells" *2 (October 25, 2002).

Regulation re-inspection schedule

Items to be implemented by the end of 2002, at the latest, so as not to hinder trial marketing of fuel cell-powered vehicles (5 items)

The study results show no problem in trial introduction.

Items to be implemented by the end of FY2004, when initial introduction of commercial-level fuel cells is assumed (23 items)

Acquisition of test data centered on the private sector side, and preparation of an example standards plan by FY2003

Confirmation of safety by the regulating government agency side, and implementation of necessary measures, such as establishment of technology standards, within FY2004

Establishing a regulation system that assumes introduction of fuel cells using hydrogen as energy from 2005 and thereafter

*1. Six laws: High Pressure Gas Safety Law, Road Trucking Vehicle Law, Road Law, Building Standard Law, Fire Defense Law, Electric Utility Law

*2. Liaison conference of related government agencies: Cabinet Secretariat, Cabinet Office, National Police Agency, Fire Defense Agency, Ministry of Economy, Trade and Industry; Ministry of Land, Infrastructure and Transport, Ministry of the Environment

Past Efforts by Japan and the U.S.

U.S. Federal Government efforts

(Beginning of the Bush Administration)
(Expressed intention not to participate in the Kyoto Protocol)

(*calculated at 1 dollar equals 120 yen)

FY2002, $75.5 million (¥9.1 billion)

Announcement of the Freedom CAR Program (Jan. 2002)
Change of the program under the previous administration; technology development program related to automobiles, including fuel cell-powered vehicles

FY2003, $97.4 million (¥11.7 billion)

Hydrogen energy road map (Nov. 12, 2002)
Compiled measures on hydrogen manufacture, storage, usage, etc.

The President announced a new program regarding hydrogen, in the State of the Union speech. (Jan. 28, 2003)
Aiming to secure budget of about $1.2 billion in five years.

The U.S. and the EU signed a consensus document related to international cooperation in the hydrogen / fuel cell field. (Jun. 2003)

FY2004, $147.2 million (¥17.7 billion)

FY2005, $172.8 million (¥20.3 billion) (request)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec **2001** Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec **2002** Jan Feb Mar Apr May Jun Jul Aug Sep **2003** 2004 2005

Japanese Government efforts

Preparation of a Fuel Cell Practical Application Strategy Research Group report (Jan. 22, 2001)
Establishment of a scenario for fuel cell diffusion for the period till 2020

FY2001, ¥11.9 billion

Preparation of a technology development strategy for polymer electrolyte fuel cell / hydrogen energy use (Aug. 8, 2001)

An event featuring trial rides in fuel cell-powered vehicles, with participation by the Prime Minister, etc. (Dec. 13, 2001)

The Prime Minister mentioned practical application within three years, in an administrative policy speech. (Feb. 4, 2002)

FY2002, ¥22 billion

A Vice Minister prepared a fuel cell project team report. (May 27, 2002)

Establishment of a course of comprehensive regulation re-inspection toward practical application of fuel cells (Oct. 25, 2002)

Initiated introduction of fuel cell-powered vehicles (Dec. 2, 2002)

The Prime Minister mentioned regulation inspection and expansion of diffusion of fuel cell-powered vehicles, in an administrative policy speech. (Jan. 31, 2003)

FY2003, ¥30.7 billion

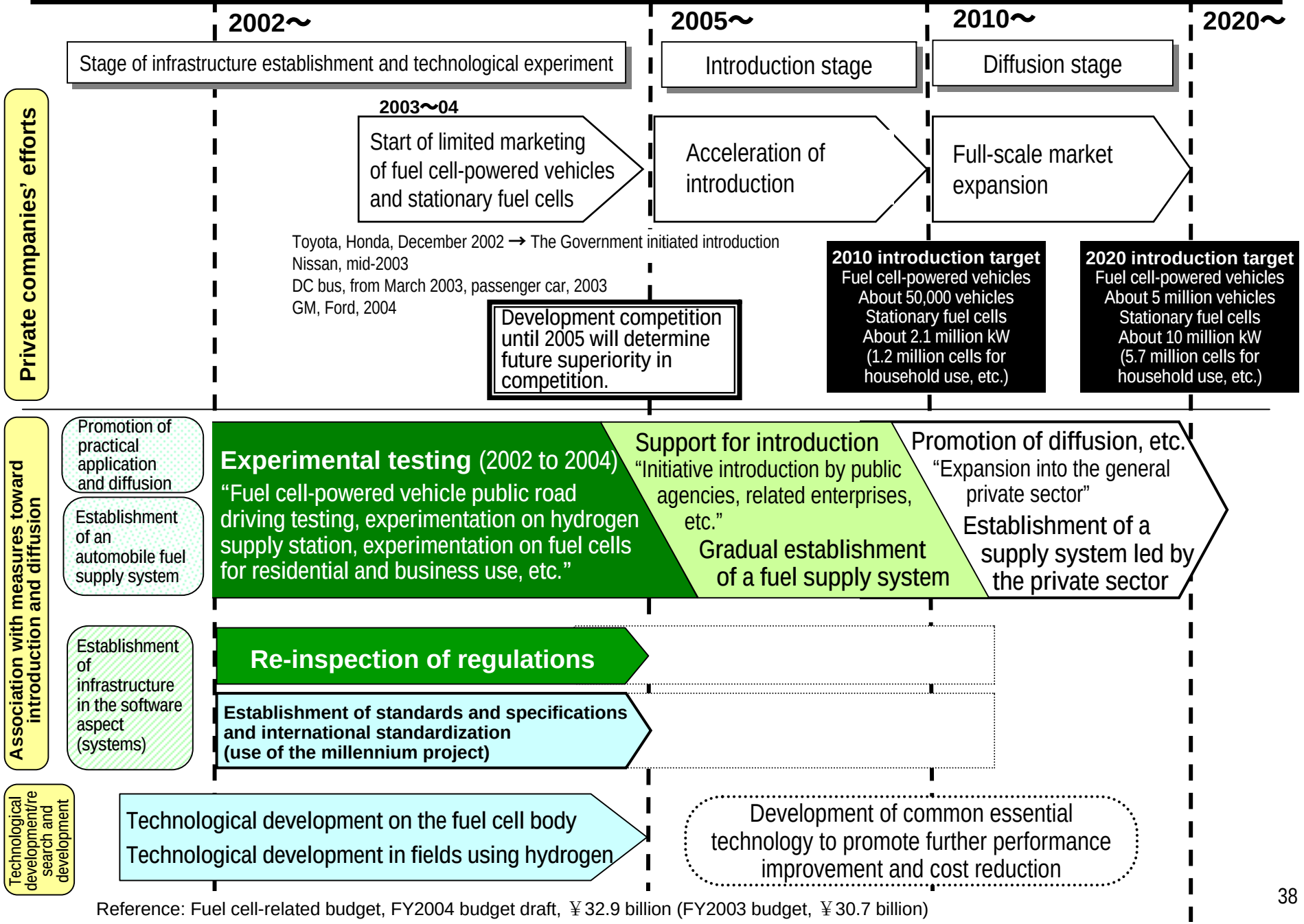
The Prime Minister stated his intention to tackle practical application of fuel cells, in an administrative policy speech at an extraordinary Diet session. (Sep. 26, 2003)

FY2004, ¥32.9 billion

A Cabinet-level meeting on international partnerships for development of the hydrogen economy (Nov. 20, 2003) / Major countries in the world gathered and agreed to promote efforts to develop the hydrogen economy.

A Japan-U.S. joint announcement on hydrogen and fuel cells (Jan. 8, 2004) / Start of negotiations toward concluding a Japan-U.S. agreement on cooperation regarding research and development on hydrogen and fuel cells and related criteria and standards.

Scenario on Introducing Fuel Cell-Powered Vehicles and Stationary Fuel Cells



Reference: Fuel cell-related budget, FY2004 budget draft, ￥32.9 billion (FY2003 budget, ￥30.7 billion)