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5. New and Renewable Energy Policies in Japan

日本の新エネルギー政策

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Significance and Tasks for an Expanded Implementation of New Energy

October 2003

New and Renewable Energy Division
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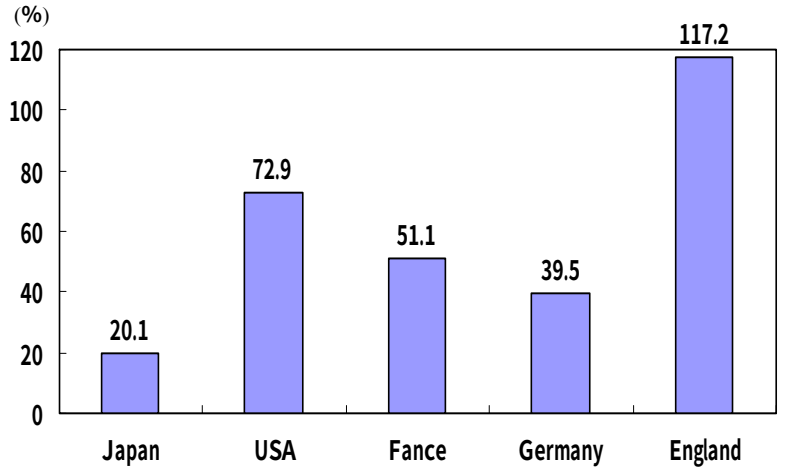
(METI)

Energy in Japan in comparison to the world

Characteristics

- *Japan tried to promote the saving of energy and the applications of oil alternative energy sources such as nuclear power after it had undergone two "oil shocks." As a result, Japan has been able to reduce its dependency upon oil to the level of approximately 50%.*
- *However, Japan's ratio of self-supply of energy hovers as low as about 20%, which remains exceedingly low in comparison to other major countries due to the fact that it suffers from scarce domestic energy resources.*
- *Particularly Japan's dependency on oil continues to remain high, especially upon the Middle East, in comparison to European and American countries. Thus, Japan's supply structure of energy is relatively fragile.*

[Ratio of the self-supply of energy in major countries (2000)]



Source: "Energy Balances of OECD Countries 1999-2000" by IEA

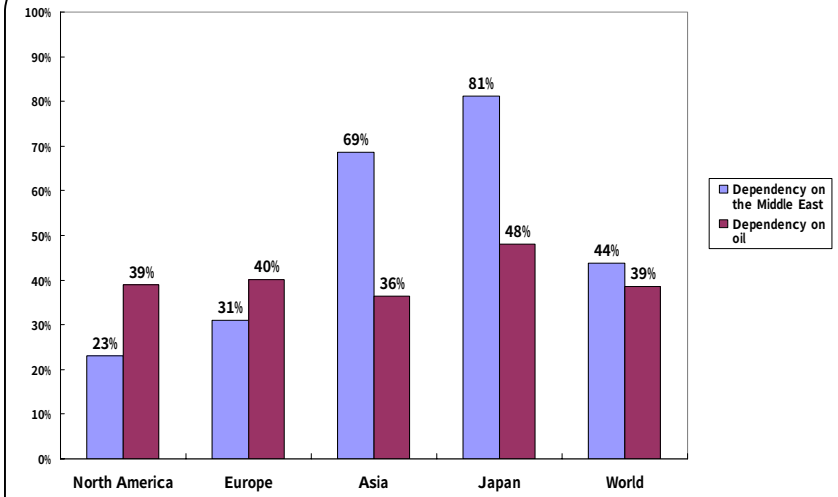
[Primary energy supply and its raito in major countries (2000)]

(%)

	Japan	U.S.A	France	Germany	England
Primary energy supply (oil conversion: one million ton)	525	2300	257	340	233
Coal	18	24	6	24	16
Oil	51	39	34	39	36
Natural gas	12	24	14	21	38
Nuclear power	16	9	42	13	10
Hydraulic power	1.4	0.9	2.2	0.6	0.2
Recyclable energy, etc.	2	4	2	3	2

Source: "Energy Balances of OECD Countries 1999-2000"

[Dependency on the Middle East for oil and dependency on oil in the world (1999-2000)]



Source: BP Statistics 2002

Control of CO_2 emission originating in energy and outlook on energy supply

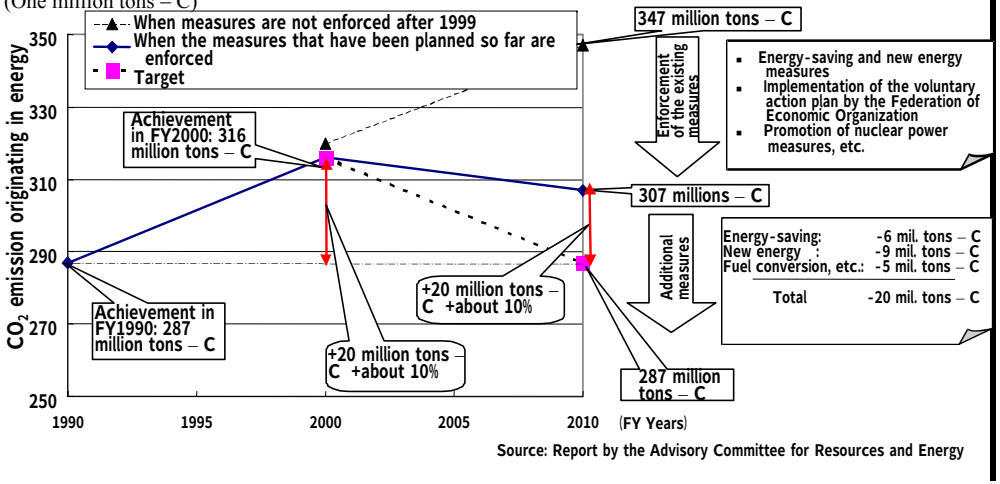
Goal

Approximately 90% of emission greenhouse effect gases are carbon dioxide originating in energy sources. This needs to be controlled to the same level as that of FY1990 in FY2010 (Policy for Promoting Global Warming Control Measures)

Problem

Demand side: A constant increase primarily in the people's livelihood and transport sectors
Supply side: Prolongation of the construction plan of nuclear power plants

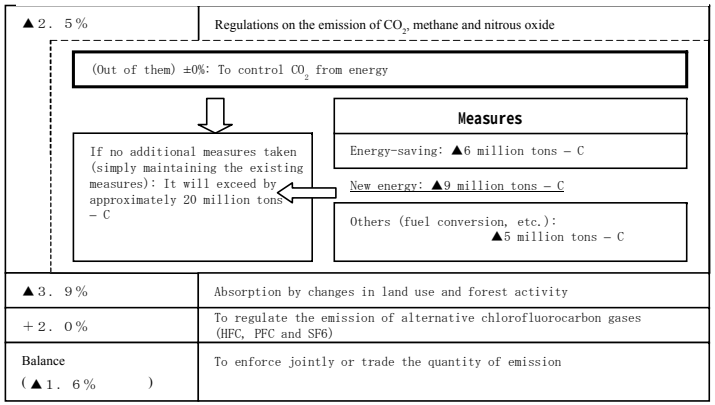
(One million tons – C)



Source: Report by the Advisory Committee for Resources and Energy

Targets of the measures to control greenhouse effect gases

CO_2 originating in energy: To reduce to approximately 287 million tons of C (the level of FY1990)



Outlook on the supply of primary energy

(Point)

Oil dependency: To reduce its level to about 45% in FY2010

(Long-term perspective on energy)

Item \ Fiscal year	FY1999 (Distribution ratio)	FY2010 (Targets) (Distribution ratio)
Oil	52%	About 45%
Coal	17%	About 19%
Natural gas	13%	About 14%
Nuclear power	13%	About 15%
Hydraulic	4%	About 3%
New energy	1%	About 3%

Outlook on generated power (Electric companies)

(Unit: One billion kWh)

Fiscal year	FY1999		FY2010	
Generated power	917.6		Approximately 997.0	
Classification by energy source	Actual	Distribution ratio (%)	Actual	Distribution ratio (%)
LNG	240.5	26.2	About 254.9	About 26
Coal	152.9	16.7	About 159.9	About 16
Oil, etc.	112.9	12.3	About 53.3	About 5
Nuclear power	316.5	34.5	418.6	About 42
Hydraulic power	893	9.7	96.2	About 10
Thermal energy	34	0.4	3.7	About 0..4
New energy	21	0.2	115	About 1
CO_2 emission (g-C/kWh)	89.9		Approximately 73.6	

Definition of new energy

What is new energy?

"New energy" is stipulated in the section of "the use of new energy" in the "Special Measures Law for Promoting the Use of New Energy" that took effect in 1997.

① New energy is such energy that particularly makes contributions to the enhancement of the use of oil alternative energy, but
② it has not been popularized due to its economic constraints
③ in the manufacture, generation and use of oil alternative energy.

Thus, new energy is classified as a target of policy support so that it will be more vigorously and dynamically applied in Japan.

The Law enumerates specifically the following sources of energy.

○ New energy on the supply side

《Power generation》
- Photovoltaic power generation
- Wind power generation
- Waste power generation
- Biomass power generation

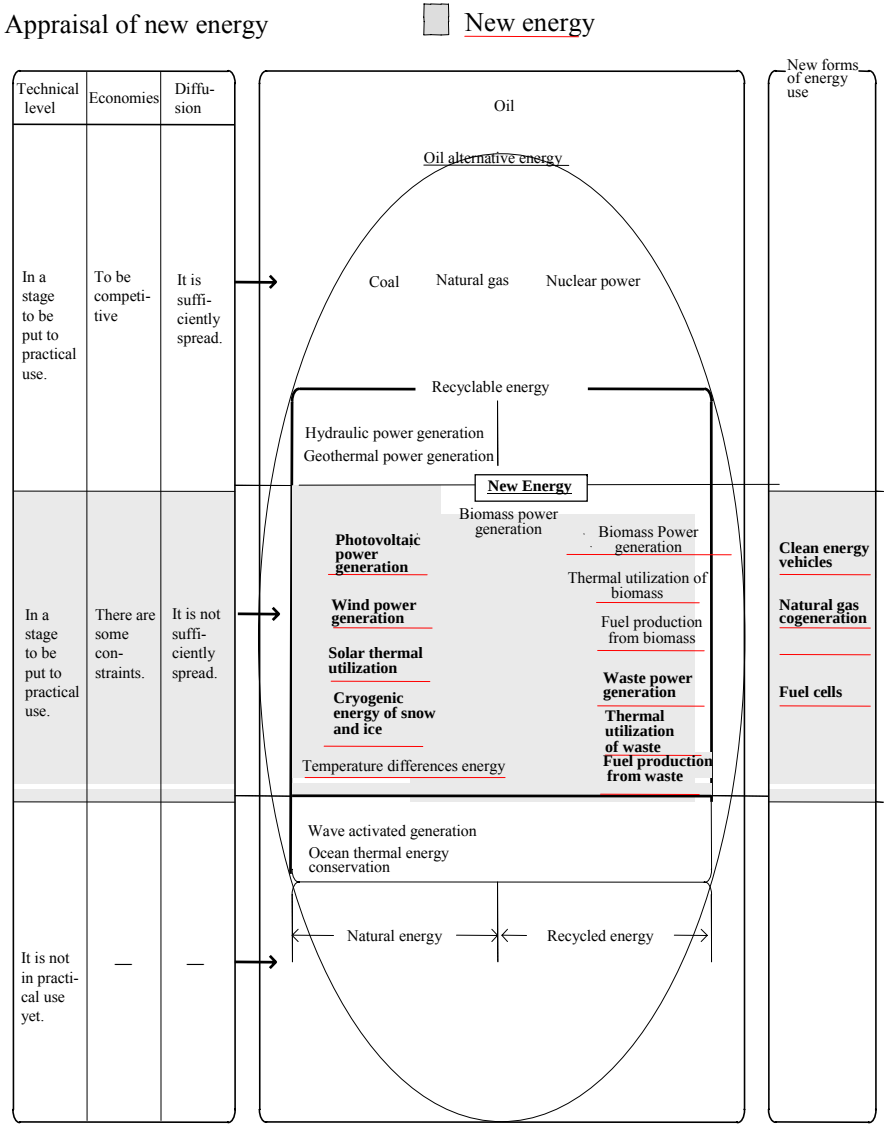
《Energy》
- Solar thermal utilization
- Thermal utilization of waste
- Thermal utilization of biomass
- Cryogenic energy of snow and ice
- Temperature differences energy

《Power generation and energy》
- Fuel production from waste
- Fuel production from biomass

○ New energy on the demand side

- Electric vehicles (including hybrid cars), natural gas vehicles, and methanol vehicles
- Natural gas cogeneration
- Fuel cells

Appraisal of new energy



(Note) "Black liquor" is a waste liquid produced during the process of pulp manufacturing.

Significance of New Energy Implementation

The significance of new energy can be expressed by the following; its emission of Carbon Dioxide is small so is its burden on the environment; it secures a stable energy supply and provides an alternative energy for oil to a country with limited natural resources; from contributing to address the global environmental concerns, to contributing to the structure of a sustainable economy; and finally, contributing to create new industry and employment by implementing new energy.

◯Contribution to securing a stable energy supply as an alternative energy to oil

- Contributes to securing stable energy supply with few limitations with regards to natural resources.
- Alternative energy to oil, contributing to a fall in the high-dependency of oil.

◯ Clean energy with a small burden on the environment

- In comparision with fossile energy, burden on the environment is relatively small (new energy on the supply side)
- In cases where energy effectiveness is high, fossile energy used can be lowered. (new enery on the demand side)

◯ Contribution to new industry and creation of employment

- A highly potential field contributing to the creation of new imdustries and employment during the development process of new technologies and products.
- Contributs to enforcing competitiveness among national companies.

◯ Advantage of creating a decentralized energy system

- Under emergencies such as taking measures against clamities, it can be used as a dependent energy system, independent of existing systematic electric power.
- It can be installed near areas in demand, thus lowering energy loss during power transmission.

◯ Possible contribution to load leveling of electric power (peak cut effects)

- Operation of photovoltaic power generation system during daytime in the summer may contribute to possible load leveling of electric power.

Achievements and Targets for Implementation of New Energy

As a result of discussion premised upon maximal efforts by the public and private sectors, the "target for introducing new energy" has been set up as 1,910,000 kl in crude oil conversion (Approximately 3% of the total supply of primary energy) on the supply side.

New energy on the supply side

		FY2001	Targets for FY2010
Field of power generation	Photovoltaic power generation	110,000Kl (452,000 kW)	1,180,000 Kl (4,820,000 kW)
	Wind power generation	127,000 Kl (312,000 kW)	1,340,000 Kl (3,000,000 kW)
	Waste power generation	1,250,000 Kl (1,110,000 kW)	5,520,000 Kl (4,170,000 kW)
	Biomass generation	48,000 Kl (71,000 kW)	340,000 Kl (330,000 kW)
Field of use of energy	Solar thermal utilization	820,000 Kl	4,390,000 Kl
	Thermal utilization of waste	45,000 Kl	140,000 Kl
	Thermal utilization of biomass	-	670,000 Kl
	Unused energy *	44,000 Kl	580,000 Kl
	Black liquor and scrape wood, etc*	4,460,000 Kl	4,940,000 Kl
Total (gross supply of primary energy ratio)		6,900,000 Kl (1.2%)	19,100,000 Kl (Approximately 3%)

New energy on the demand side

	FY2001	Targets for FY2010
Clean energy vehicles *	115,000 vehicles	3,480,000 vehicles
Natural gas cogeneration *	1,900,000 kW	4,640,000 kW
Fuel cells	12,000K kW	2,200,000 kW

* As for unused energy, it includes snow and ice cold heat.
* Black liquor and scrap wood is one of biomass so it includes those partly used as power generation.
* For clean energy vehicles, it includes electric vehicles, fuel cell vehicles, hybrid vehicles, natural gas cars, methanol vehicles and diesel alternatice LP gas vehicles.
* For natural gas cogeneration, it includes products by fuel cells.

International comparisons of Japan's achievements in the applications of new energy

〈 International comparisons of photovoltaic power generation and wind power generation 〉

Capacity of facilities (one thousand kW)					
Photovoltaic power generation (As of the end of FY2001)			Wind power generation (As of the end of December 2002)		
① Japan	452.2	46.0%	① Germany	10,900	37.4%
② Germany	194.7	19.8%	② U.S.A.	4,708	16.2%
③ U.S.A.	167.8	17.1%	③ Spain	4,079	14.0%
④ Australia	33.6	3.4%	④ Denmark	2,889	9.9%
⑤ Netherlands	20.5	2.1%	⑤ India	1,702	5.8%
⑥ Italy	20.0	2.0%	⑥ Italy	755	2.6%
⑦ Swiss	17.6	1.8%	⑦ Netherlands	677	2.3%
⑧ Mexico	15.0	1.5%	⑧ England	552	1.9%
⑨ France	13.9	1.4%	⑨ China	399	1.4%
⑩ Spain	9.1	0.9%	⑩ Japan	351	1.2%
⑪ Canada	8.8	0.9%	⑪ Sweden	310	1.1%
⑫ Austria	6.6	0.7%	⑫ Greece	276	1.0%
⑬ Norway	6.2	0.6%	⑬ Canada	221	0.8%
⑭ Korea	4.8	0.5%	⑭ Portugal	171	0.6%
⑮ Sweden	3.0	0.3%	⑮ France	147	0.5%
⑯ Finland	2.8	0.3%	⑯ Ireland	138	0.5%
World's total	98.22	100%		2,914.0	100%

* As for wind power, the value of Japan is based upon the survey by NEDO (as of the end of March 2001).

[Source]
・The figure of photovoltaic power generation as of the end of 1999 is based upon the IEA statistics by NEDO.
・The figure of wind power generation as of Dec. 2000 is taken from "Wind Power Monthly April 2001."

〈 Ratio of recyclable energy in the total supply of energy in each country 〉

(Recyclable energy: sunlight, wind, waste, hydraulic (excluding pumping) and geothermal)

	Supply of primary energy		In terms of generated power	
	Results in 2000	Target for 2010	Results in 2000	Target for 2010
Japan	4.8%	About 7%	10.2%	About 11%
U.S.A.	5.0%	6.9%	8.5%	9.2%
Canada	16.8%	-	60.5%	-
E.U.	6.0%	12.0%	15.3%	22.1%
England	1.1%	-	2.8%	10.0%
France	6.8%	-	13.2%	21.0%
Germany	3.3%	-	7.3%	12.5%
Italy	5.2%	-	19.0%	25.0%
Denmark	10.8%	-	17.5%	29.0%
Sweden	32.7%	-	57.1%	60.0%
Austria	23.8%	-	72.6%	78.1%

[Source]
- ・ Japan's result for FY2000: by Agency for Natural Resources and Energy
- ・ Japan's target for FY2010: General Resources Energy Investigation Response (July 2001)
- ・Overseas' results for 2000 : "Energy Balance of OECD Countries 1999-2000" (2002 Edition)
- The 2010 target figure of USA for the total supply of primary energy: The above-stated report
- The target of EU for 2010: EU Injunction for 2010 (September 2001)

Problems in the applications of new energy and efforts to overcome the problems (Stable output)

Problems concerning stability in output

The use of natural energy sources such as photovoltaic power generation and wind power generation inevitably depend upon sunlight and wind conditions. As a result, the output is unstable.

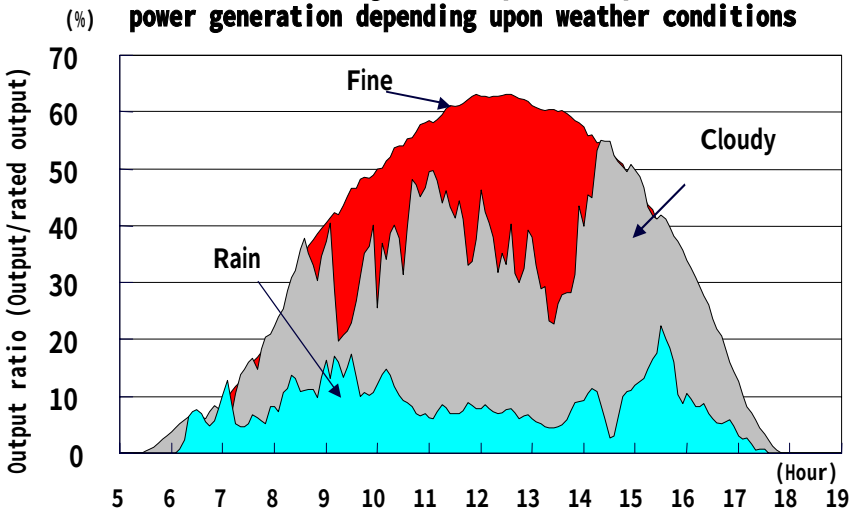
Therefore, they can be used only as supplementary sources of power instead of a stable source of power. It is necessary that it is used in combination with an adjusting source of power or storage batteries to ensure a stable supply of power.

It has been pointed out that the quality of electric power may be deteriorated together with an increasing number of cases in which the existing electric power system is linked with a new energy system such as a large scale wind power generation that has an unstable output.

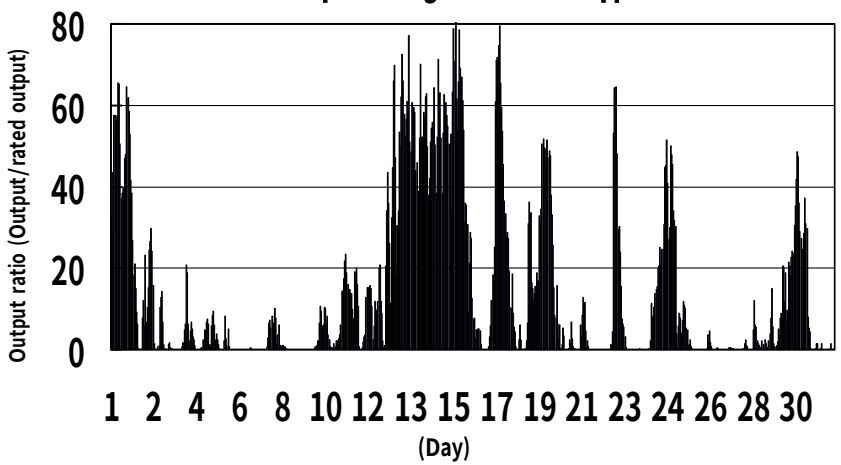
Efforts to overcome the problems

Studies have been conducted such as validation researches on the voltage fluctuations and frequency fluctuations of an electric power system concerning the method in which photovoltaic power generation or wind power generation is used in combination with storage batteries.

Transition of the generated power of photovoltaic power generation depending upon weather conditions



Transition of output in August 1999 at Tappi Wind Park



Problems in expanding the applications of new energy (Economies)

Problems concerning economies

Undoubtedly the facility cost and power generating cost have been cut down owing to past technical development and the implementation of the measures to enhance applications. However, the costs still remain at a higher level in comparison to the existing sources of energy.

The cost of photovoltaic power generation (for domestic use) is higher by approximately 2～3 times in comparison to power rates for domestic use.

The cost of wind power generation (about \9～14/kWh) has been on the decrease in tune with cost reductions in construction due to the fact that its facilities are getting larger. On the other hand, with respect to small/medium-sized facilities, the cost of electricity still remains more expensive.

Efforts to overcome the problems

We will implement the projects to support new energy applications including subsidies for the development of technology conducive for higher energy conversion efficiency and the early establishment of independency in its marketability.

(For instance, the provisional goal in the case of photovoltaic applications in private houses is to attain the level of the present power rates for domestic use.)

○ Power generation costs of new energy

(unit: yen/kWh)

Type	Photovoltaic power		Wind power		Waste power		Biomass	Small and Medium hydraulic power
	Household	Non-household	Large scale	Small & medium	Large scale	Small & medium		
Cost	46~66	73	9~14	18~24	9~11	11~12	7~21	14

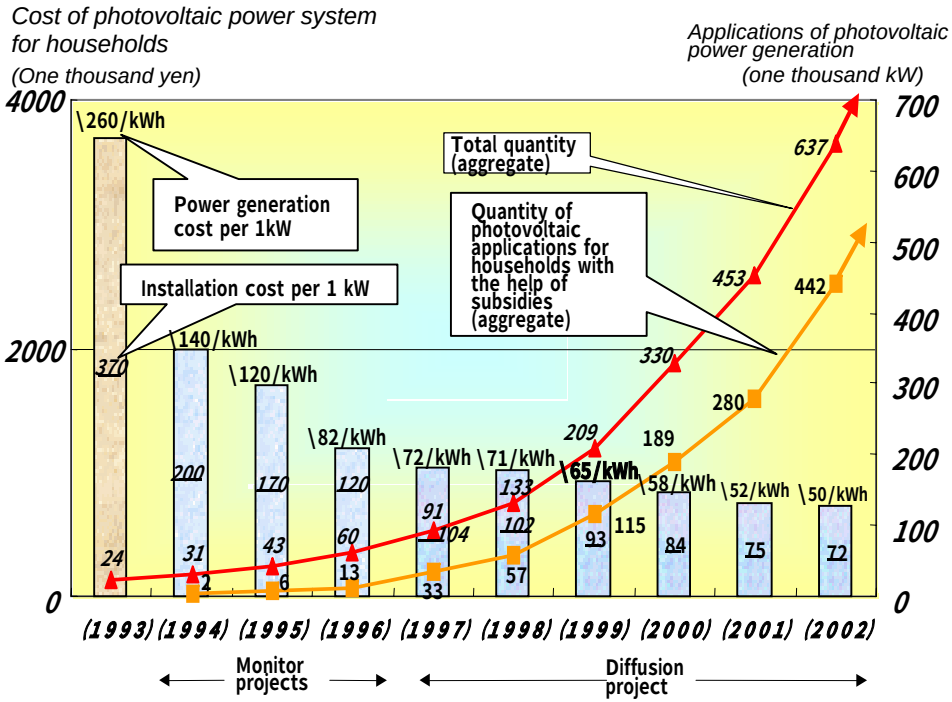
(Source) Report by the New Energy Sectional Meeting of the Advisory Committee for Resources and Energy (June 2001) and etc.

Conceptual image of efforts for improving the economies of new energy

Transition of the economies of photovoltaic power generation for domestic use

The price of an average system has been sliced down to approximately \720,000 per kW, which is equivalent to about one-fifth of the price of FY1993, through technical development over a period of some 20 years, the surplus power menu by electric companies (since 1992) and subsidies to construction by the national government.(since 1994)

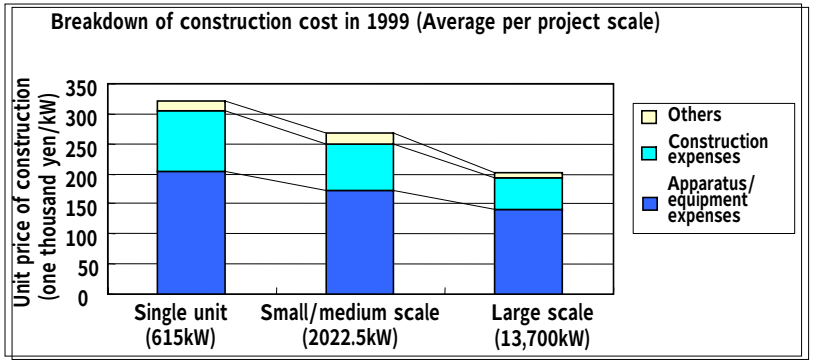
Transition of the applications of the photovoltaic power generation system for households and its price and generation cost

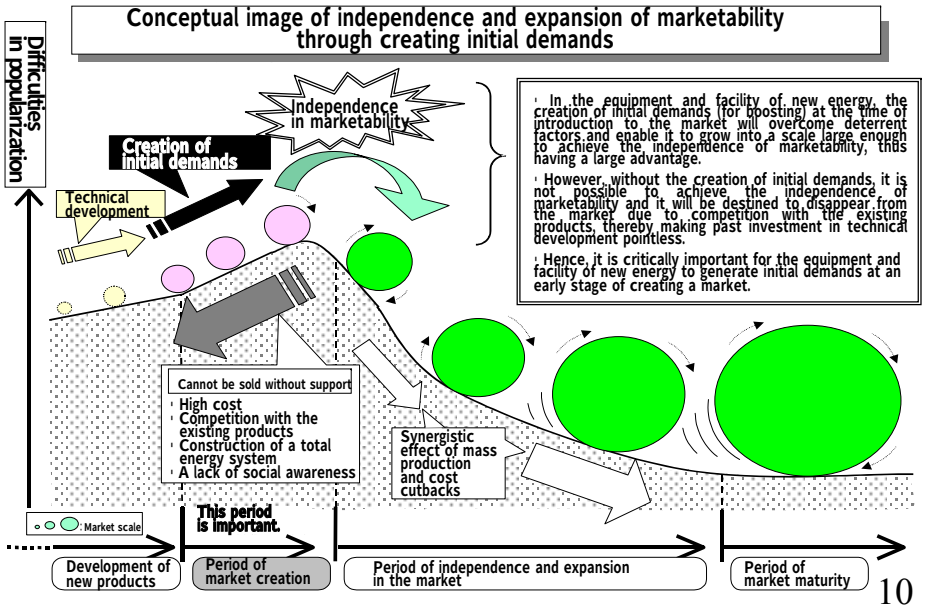


Source: Trial computation by the Ministry of Economy, Trade and Industry through hearings from makers

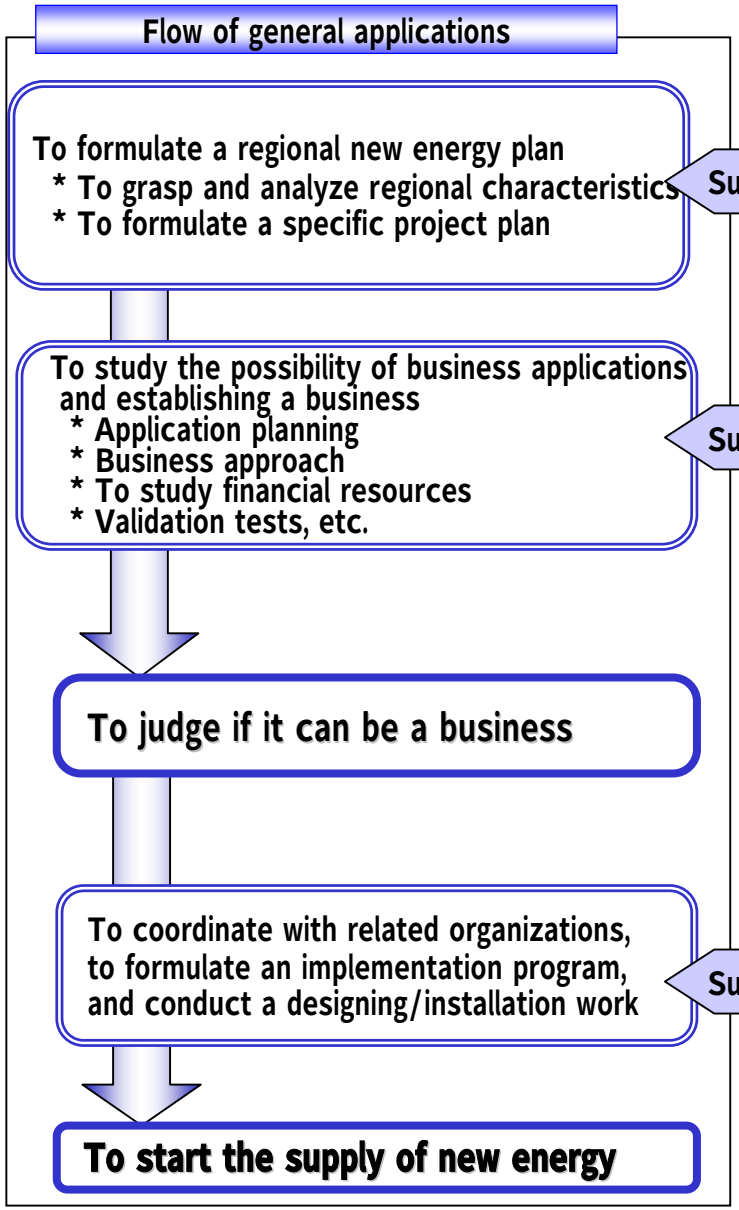
Relationship between the scale of wind power generation facility and economies

The larger the scale of wind power generation facility gets, the lower the cost of wind power generation goes down. In recent years, its equipment and facility scale have been growing larger.





Support system for expanding the use of new energy



Support

Support

Support

Main support systems

Project to formulate a regional new energy vision (for local public bodies)
To subsidize a part of the project expenses of a local public body for formulating a plan to identify diverse sources of energy that may be lying unexplored and imbue new air into a region for its vitalization towards the 21st Century (Subsidy: Fixed amount)
FY2002 Budget: \1.23 billion → Requested budget for FY2003: \1.32 billion

Validation tests of unused energy including biomass
(For business proprietors and local public bodies)
To subsidize a business proprietor for its project expenses to conduct validation tests or investigation studies on potentiality as a business to utilize unused resources in a region such as biomass as energy

FY2002 Budget: \1.1 billion → Requested budget for FY2003: \2.82 billion
- ○ Validation test project: Subsidy: Within 1/2 (Upper limit: ￥50 million per project/year)
- ○ Potentiality investigation project: Subsidy: Fixed amount (Upper limit: \10 million per case/year)

Project for promoting regional new energy applications (for local public bodies)
subsidize a local public organization for its project expenses to conduct model projects or advanced challenges such as a large-scale or intensive applications of new energy (Subsidy: Within 1/2)
FY2002 Budget: \12.7 billion → Requested budget for FY2003: \12.71 billion

Project to subsidize new energy business (for business proprietors)
To subsidize a business proprietor for his/her project expenses who takes initiatives in the application of new energy according to the plan approved based upon the New Energy Law (Subsidy: Within 1/3)
FY2002 Budget: \23.62 billion → Requested budget for FY2003: \38.82 billion

To strengthen the policy towards expanding the applications of new energy

Legislation

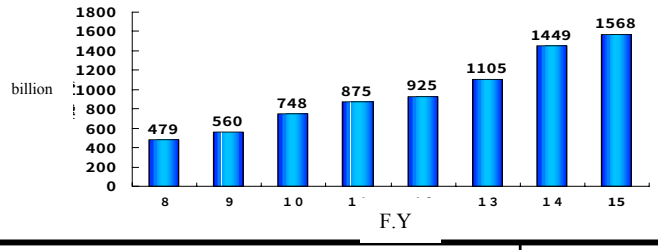
January 2002: Two categories, i.e. "biomass power generation and the use of its energy" and "the use of snow/ice energy," were added to the targets as new energy stipulated in the Law for Promoting the Use of New Energy. (The national government began its support for application projects in FY2002.)
May 2002: "The Special Measures Law for Promoting the Use of New Energy by Electric Business Proprietors" was established. (The Law obligates each electric business proprietor to increase annually the ratios of power generation by new energy sources such as photovoltaic power, wind power and biomass power from April 2003.)

Budget

○Change in budget (right graph)

・Budget related to new energy for FY2003 156.8 billion
(An increase of ¥11.9 billion in comparison with the previous year.
A three fold increase within the last 7 years.)

Change in budget related to new energy



○Budgetary structure

	Content	Project	Requested budget for FY2003 (The figures in parentheses are for FY2002)
Technical development	Technical development is carried out concerning important development issues in order to reduce the cost of new energy technology and to improve performance.	・Related to photovoltaic power generation (¥7.4 billion) ・Related to wind power generation (¥2.3 billion) ・Related to fuel cells (¥23.4 billion) ・Related to biomass (¥2.8 billion)	Approximately ¥43.4 billion (About ¥38.8 billion)
Validation test	Based upon the results of technical development, validation tests are performed to authenticate and confirm the effectiveness of the practical use of new technology including the selection, elucidation of and measures for problems that pose obstacles in the applications and marketability of the technology that has been developed.	・Field test of new technology in photovoltaic power generation (¥3.5 billion) ・Validation studies of centrally linked photovoltaic power generating system (¥2.4 billion) ・Validation tests of unused energy including biomass (¥2.8 billion) ・Validation studies on solid macromolecule type fuel cells (¥3.9 billion)	Approximately ¥18.8 billion (About ¥10.0 billion)
Promotion of application	With respect to new energy that is in the stage of application, initial demands will be created to help it achieve independence in marketability at the earliest possible time by mass-production. Support is provided to the advanced applications of new energy by business or a local public body in an intention to spread a similar project.	・Support for the application of a photovoltaic power generating system for households (¥10.5 billion) ・Support for the introduction of clean energy vehicles (¥15.4 billion) ・Measures to support new energy business (¥38.8 billion) ・Measures to promote regional new energy applications (¥12.7 billion)	Approximately ¥94.6 billion (About 96.1billion)

Summary of Special Measures Law Concerning the Use of New Energy by Electric Business Proprietors

The Law obligates each electric buiness proprietors to utilize electricity generated by new energy sources above a certain level and it targets an even more expanded application of new energy in the electricity field. Also, it aims to contribute to securing a stable supply of energy and to conserve the environment. *So called RPS (Renewables Portofolio Standard) (enforced in 2002)

- Types of New Energy
  1 Wind power
  2 Photovoltaic power generation
  3 Thermal heat (which does not cause marked reduction of hydrothermal)
  4 Small and medium hydraulic power (hydrographically below 1,000Kw)
  5 Biomass
  →Electricity such as new energy: electricity that can be obtained from facilities, which convert new energy to electricty, approved by the Ministry.
- Amount of electricity such as new energy that must be utilized
  By FY2010, for all electric business proprietors, roughly over 1.35% of the electricity supplied must be of new energy. (To be divided propotionally so as to make it 12,2 billion kWh nationwide)
  ・ By FY2009, take into consideration the utilization of electricity such as new enery and take measures agaisnt the progress.
  ・For FY2003, about 0.39% of the average electricity supplied by 10 general electric companies must be of new energy. (about 3,3 billion Kwh)
- Electric business proprietors are to select the most effective method from below:
  1 Generate electricity such as new energy by themselves
  2 Purchase electricity such as new energy from other electric business proprietors.
  3 Purchase “the equivalent amount of electricity such as new energy”
  *“The equivalent amount of electricity such as new energy”:In order to fullfill its obligation, an electric business proprietor is able to trade the amount corresponding to electricity such as new energy utilized by other electric business proprietors. It is equivalent to the value of new energy. Through this trade, electricity in areas that are difficult to install new energy can fullfill its obligation beyond the designated area, at the same time, making use of market function.
- Its obligation takes effect in April 2003.

Electric business proprietor (retailer) obligated by the Law (23 in total)

[General electric company] (10 companies in total)

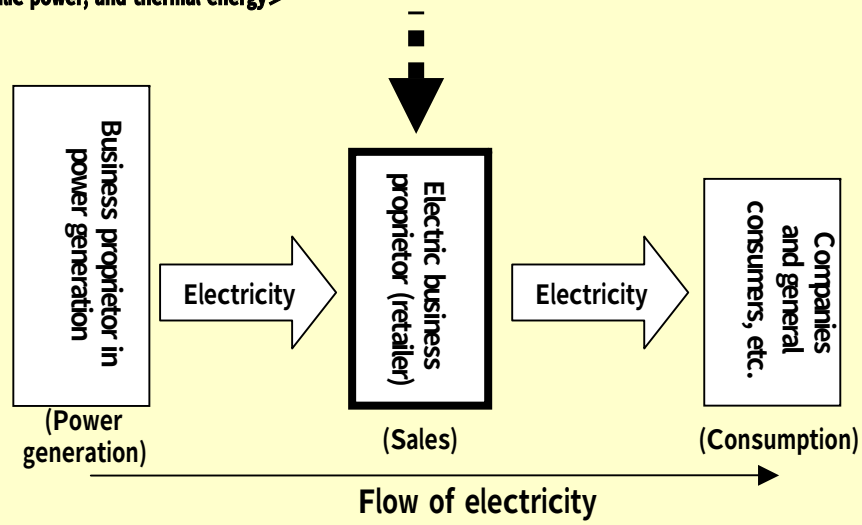
Hokkaido Electric Company, Ltd.
Tohoku Electric Company, Ltd.
Tokyo Electric Company, Ltd.
Chubu Electric Company, Ltd.
Hokuriku Electric Company, Ltd.
Kansai Electric Company, Ltd.
Chugoku Electric Company, Ltd.
Shikoku Electric Company, Ltd.
Kyushu Electric Company, Ltd.
Okinawa Electric Company, Ltd.

[Specified-scale electric business proprietor and specified electric business proprietor] (15 companies in total)

Diamond Power Co., Ltd.
eREX Co., Ltd.
Suwa Energy Service Co., Ltd.
Amagasaki Utility Service Co., Ltd., and others

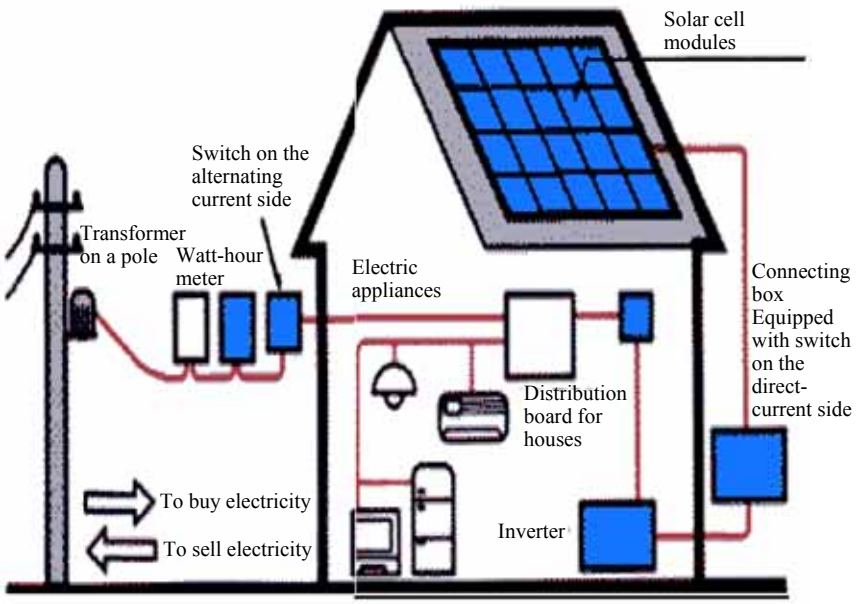
(As of May 2003)

<Power generation by wind, sunlight, biomass, hydraulic power, and thermal energy>



What is photovoltaic power generation?

It is a power generating system that directly converts sunlight energy into electricity with solar cells (semiconductor elements) by applying the phenomenon in which electricity is generated when light shines upon silicon semiconductors.



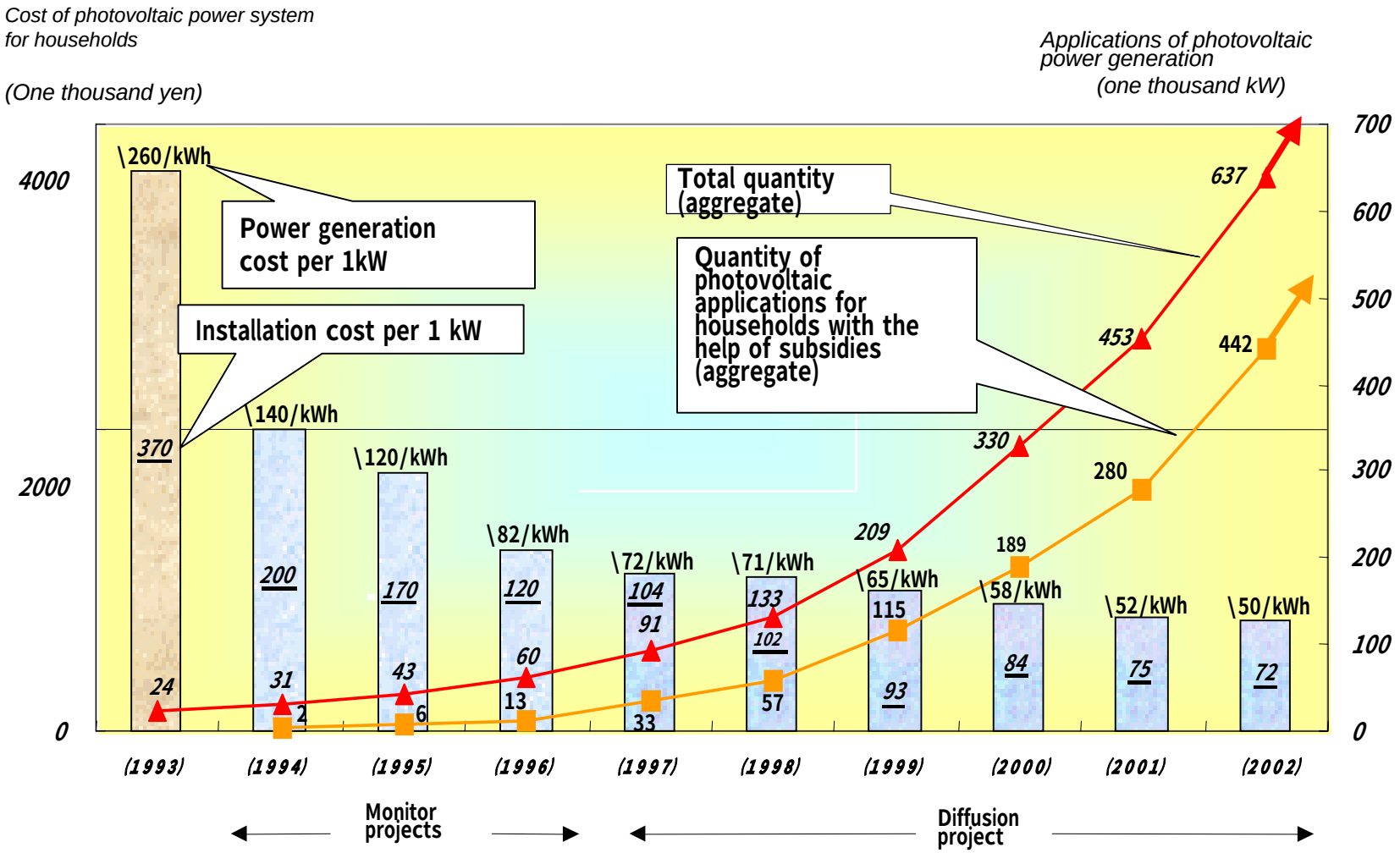
* Inverter: It converts generated direct current into alternating current
* Measuring instrument: It computes electricity to buy from and to sell to an electric company.

When 3.5kW is established

- Site area: 35m^2
- Generated power: Approximately 3,680kWh/year
(Equation: 3,680kWh/year = 3.5kW x (24h x 365D) x Capacity factor 12%)
- Electricity consumed by a general household:
About 3,600kWh per year
- Service life: More than 20 years
* Statutory service life: 15 years
- Cost: Approximately ¥2,600,000
including construction expenses (FY2001)

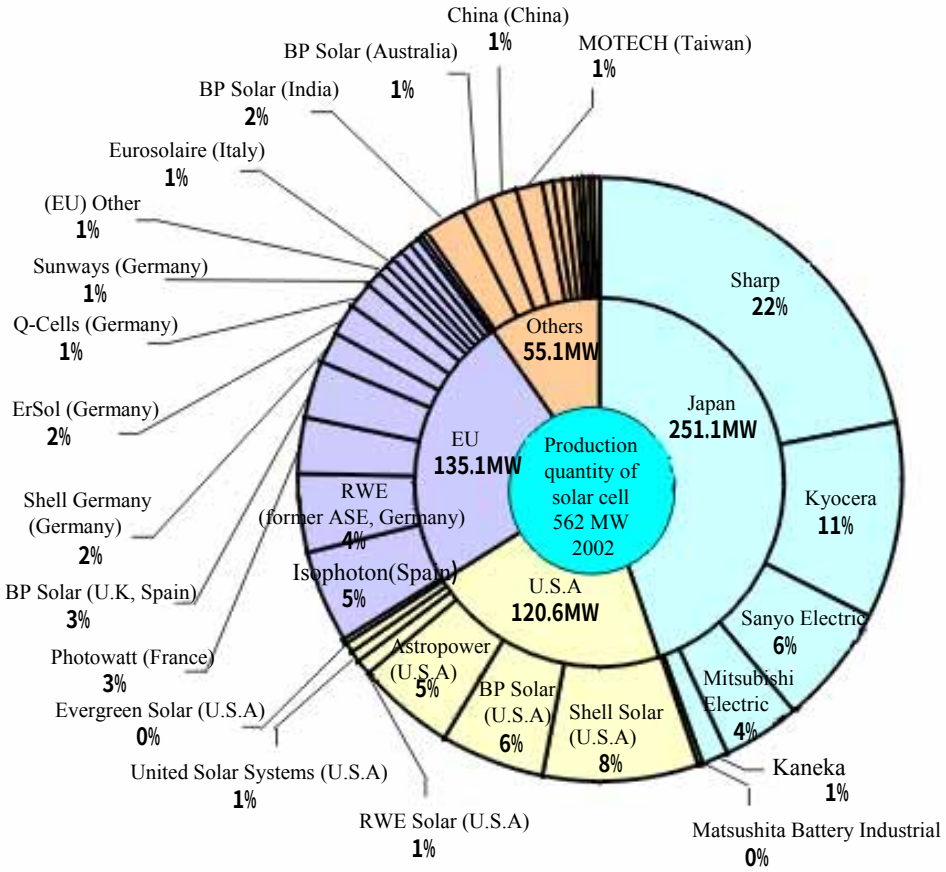
(Notes)
■ "Generating facility (kW)" is equivalent to the "size of the bore" of a water pipe.
■ "Generated power (kWh)" is equivalent to the "quantity of water" that has come out of a water pipe.

Transition of the applications of the photovoltaic power generation system for households and its price and generation cost



Source: Trial computation by the Ministry of Economy, Trade and Industry through hearings from makers

Share of Solar Cell Production by Country and Company in 2002

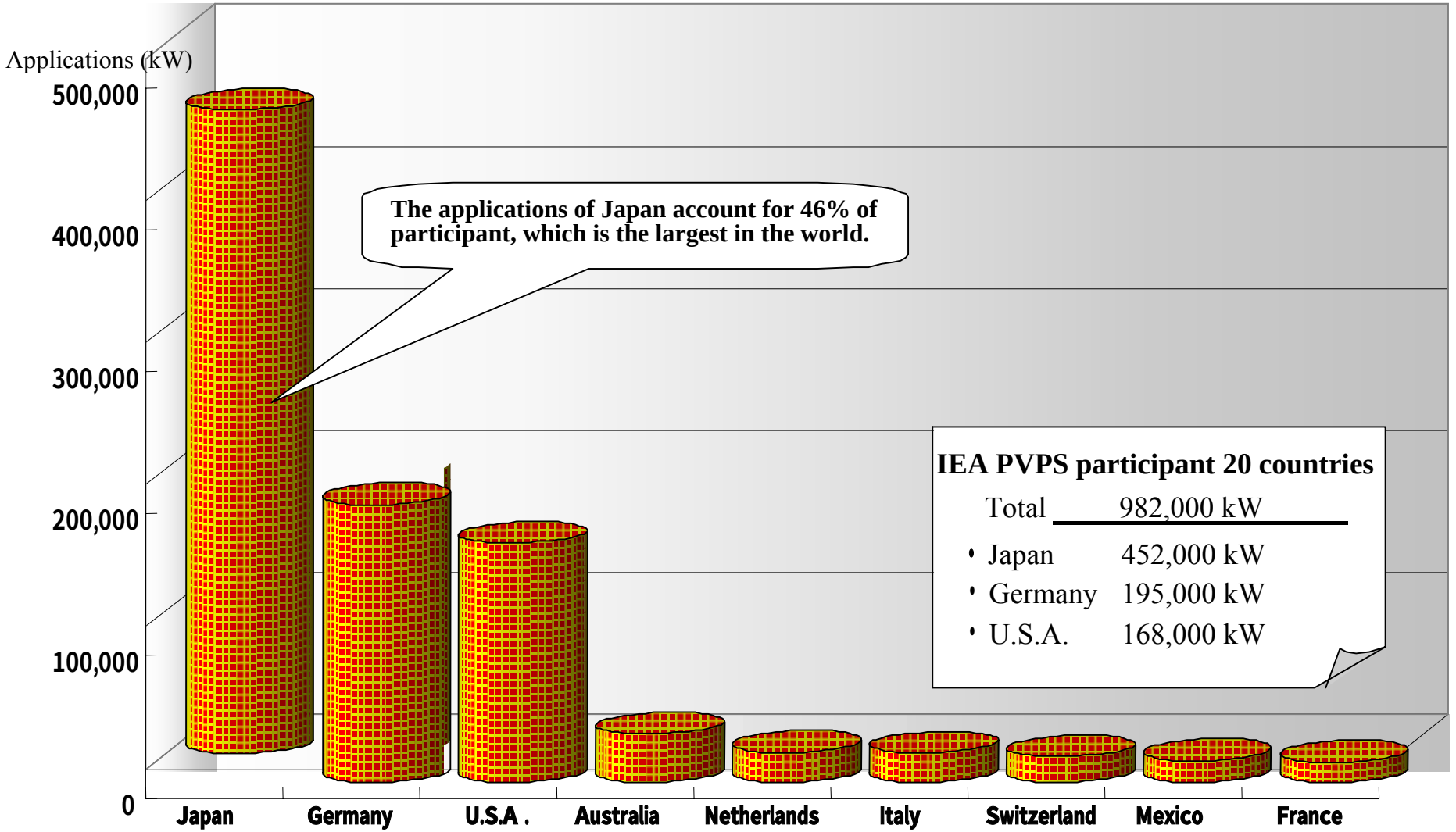


Production quantity of solar cell by country

PV NEWS

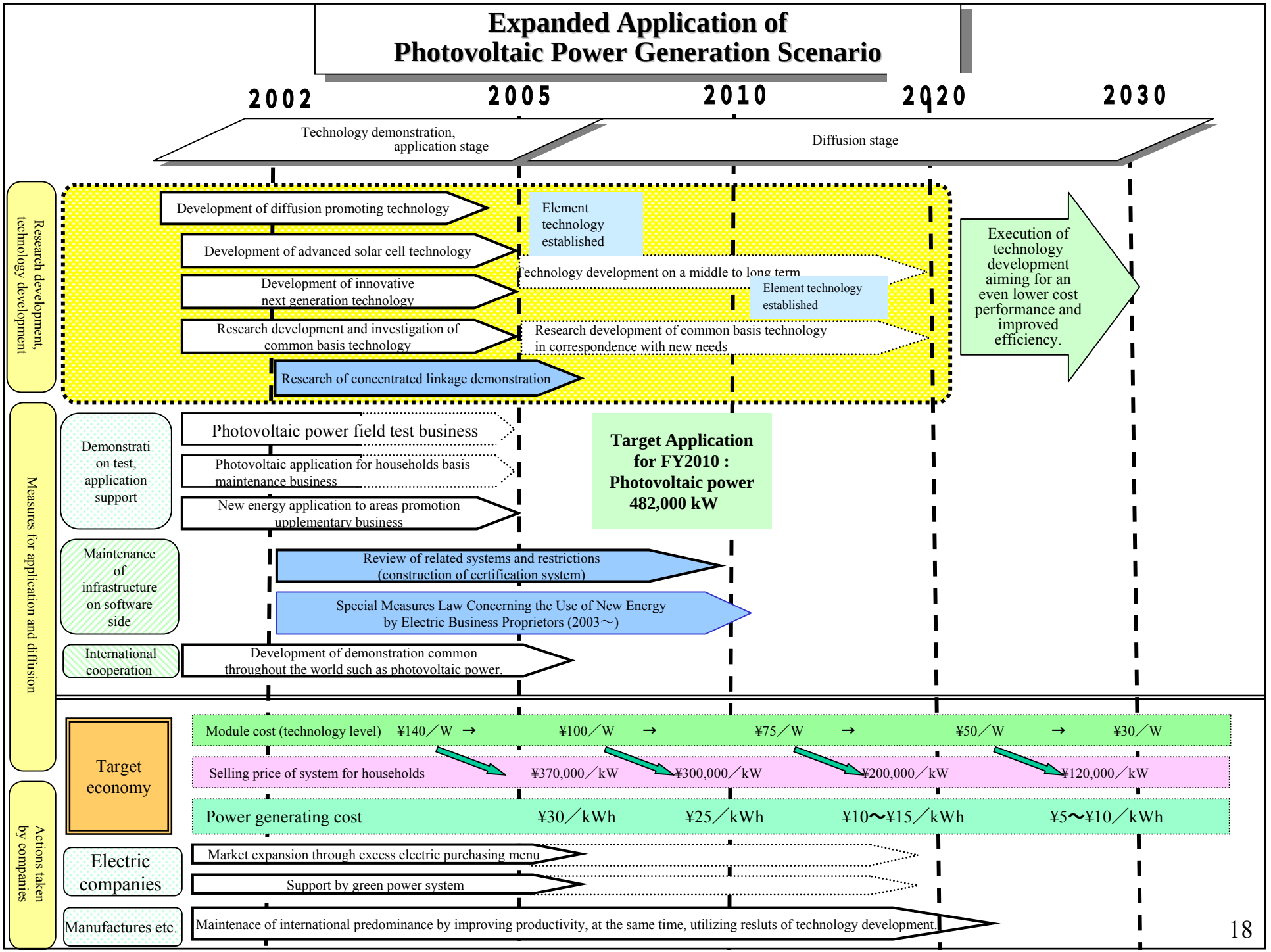
		1998	1999	2000	2001	2002
U.S.A	Production quantity (thousand kW)	5.4	6.1	7.5	10.0	12.1
	Ratio with previous year (%)	105.3	113.2	123.3	133.8	120.2
Japan	Production quantity (thousand kW)	4.9	8.0	13.0	17.1	25.1
	Ratio with previous year (%)	140.0	163.3	162.0	132.1	146.6
EU	Production quantity (thousand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

Recent photovoltaic applications (international comparisons)



Source: Trends in Photovoltaic Applications by IEA/PVPS (As of 2001)
Australia, Austria, Canada, Switzerland, Denmark, Germany, Spain, Finland, France, U.K, Israel, Italy, Japan, Korea, Mexico, The Netherlands, Norway, Portugal, Sweden, U.S.A

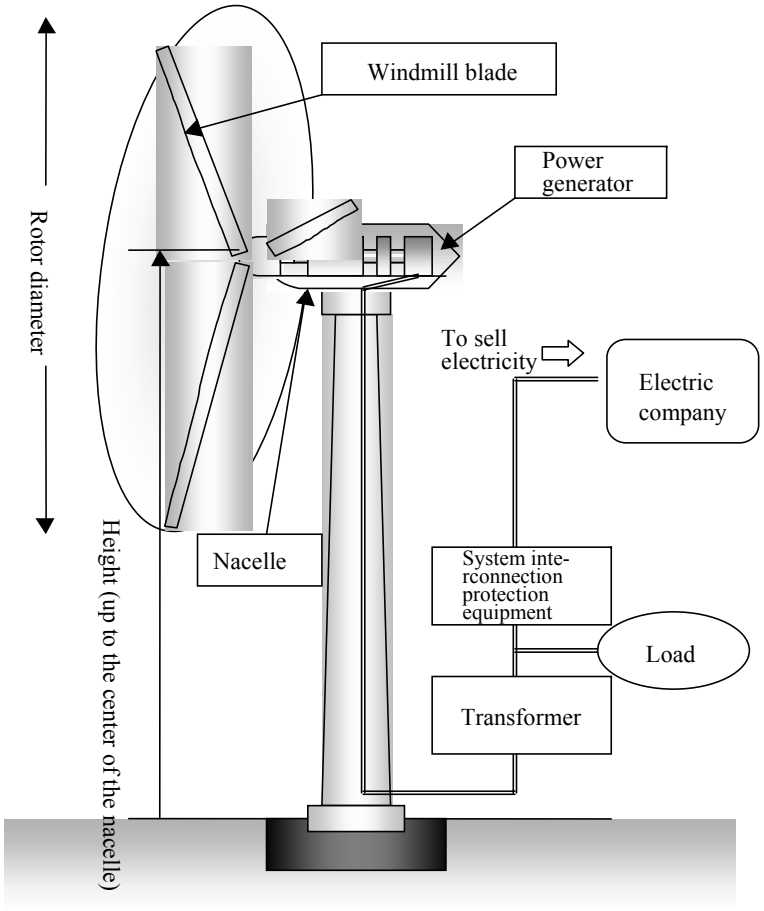
Expanded Application of Photovoltaic Power Generation Scenario



What is wind power generation?

It is a power generating system in which "wind power" rotates windmills and their rotational motions are conveyed to a generator.

(Propeller-type wind power generating system)



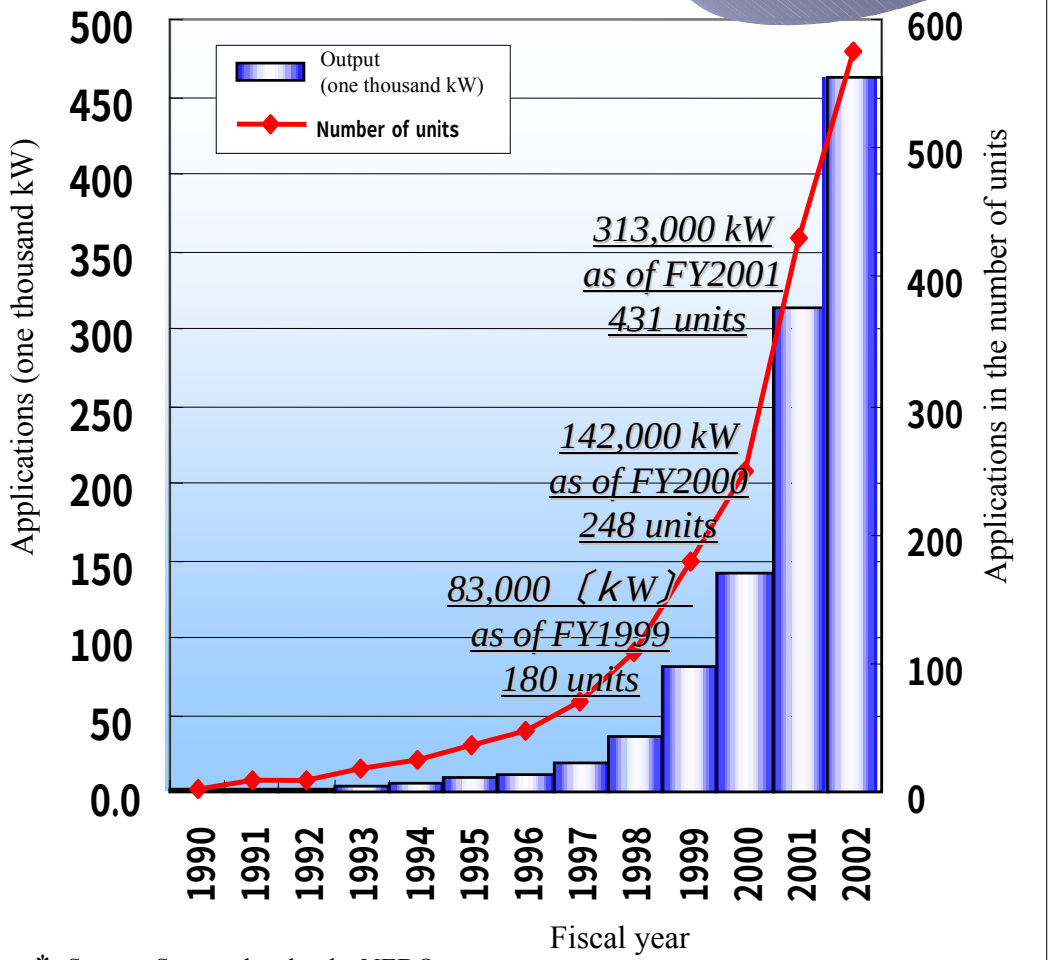
When 1000kW is established

(Rotor diameter: D = 56m;
Height (up to the center of the nacelle): 60m)

- Required area: Approximately 50,000m^2
- Generated electricity: Approximately 1,750,000 kWh/year
  (Equation: 175 kWh =
  1000 kW x (24h x 365D) x Capacity factor 20%)
  (For about 486 general households)
- Service life: 17 years (statutory service life)
- Cost: Approximately 200～300 million yen
  including construction expenses (FY2000)

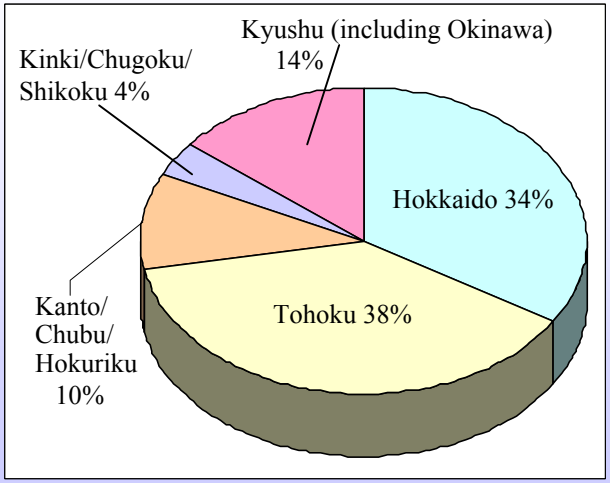
Change in domestic application of wind power generation

Actual applications



* Source: Survey data by the NEDO

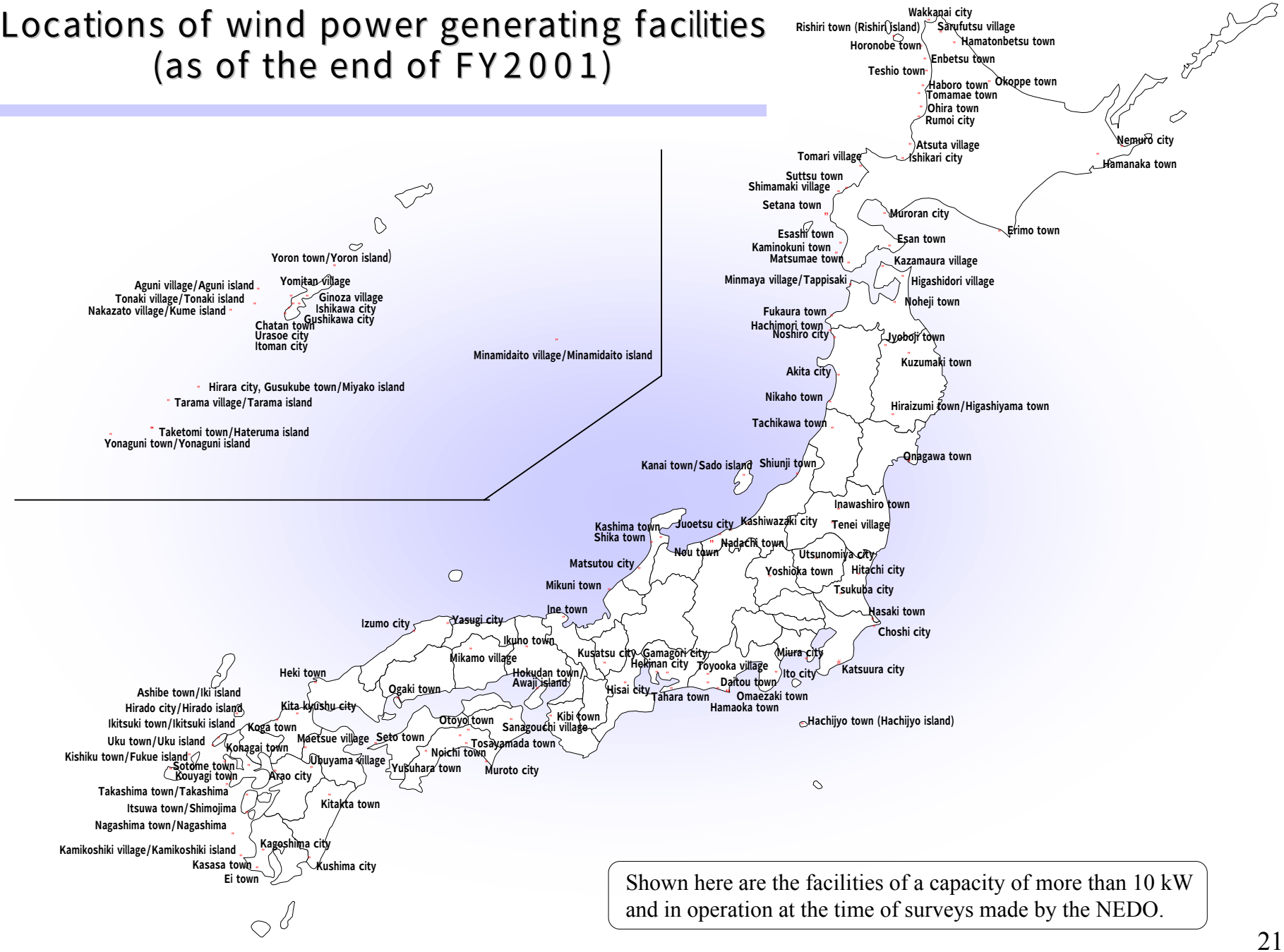
Applications by region (FY2002)



Photovoltaic applications in each region in order of the quantity of applications (As of the end of FY2002)

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

Locations of wind power generating facilities (as of the end of FY2001)



Shown here are the facilities of a capacity of more than 10 kW and in operation at the time of surveys made by the NEDO.

Expanded Application of Wind Power Generation Scenario

2002 2005 2010

Application stage

Diffusion stage

Technology development, demonstration test

- **Wind conditions**
  - Development of predicting model of regional wind conditions → Map of wind conditions
- **Windmill**
  - Wind power generation technology development for distant islands → Technology progress at wind power generation companies
- **Stabilizing system**
  - Power generation side: Technology development such as stabilizing wind power generation electricity system
  - System side: Examination of electricity system measures→demonstration test
- Evaluation and examination of existing installed units

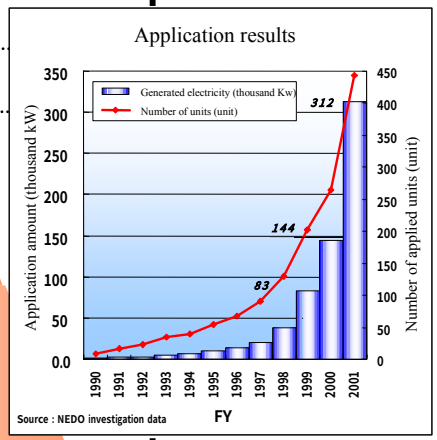
Measures for application and diffusion

- **Maintenance of hardware infrastructure/ application support**
  - Application support (review of supplementary scheme)
  - Examination of electricity system measures → System enforcement support measure
- **Maintenance of infrastructure on software side**
  - Special Measures Law Concerning the Use of New Energy by Electric Business Proprietors (2003～)
  - Examination of reviewing related systems and restrictions aiming for an expanded market
  - Examination of international standardization related to wind power generation and construction of certification system

Actions taken by companies

- Electric companies: Support by green power system
- Proprietors: Accumulation of business expertise, improvement of productivity through operation control and preparation of maintenance system.

Actions towards new demand expansion (development and diffusion of a miniaturized windmill)

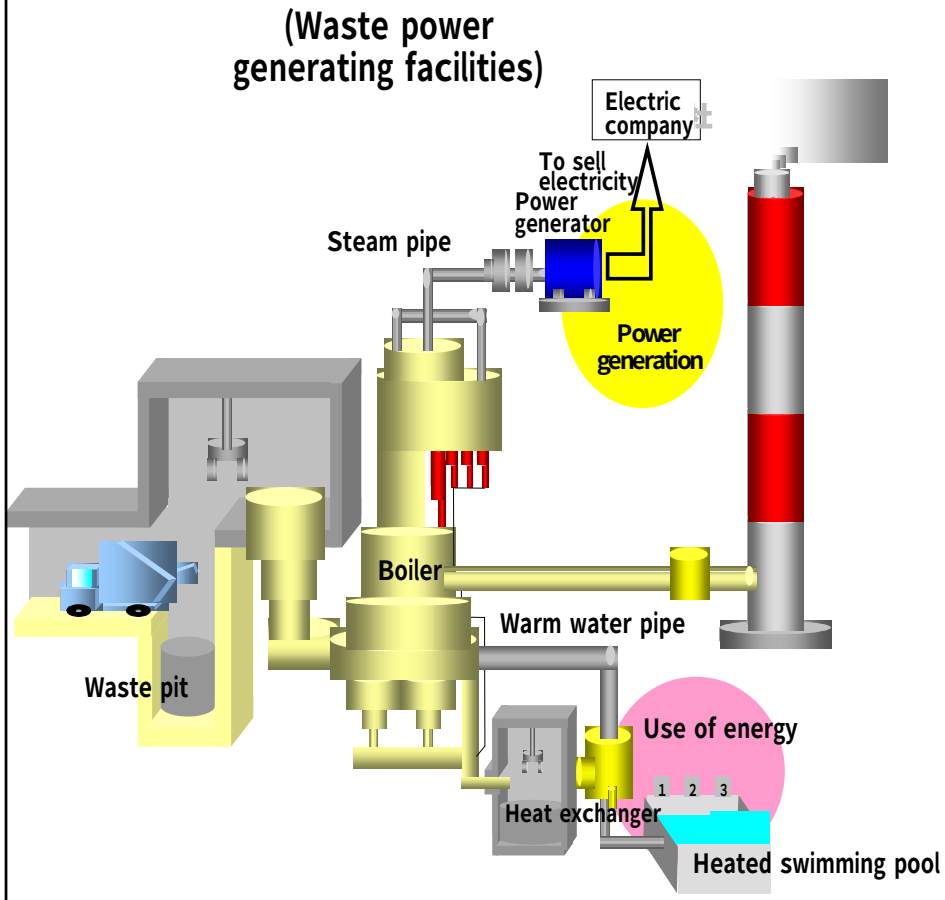


Target application for 2010

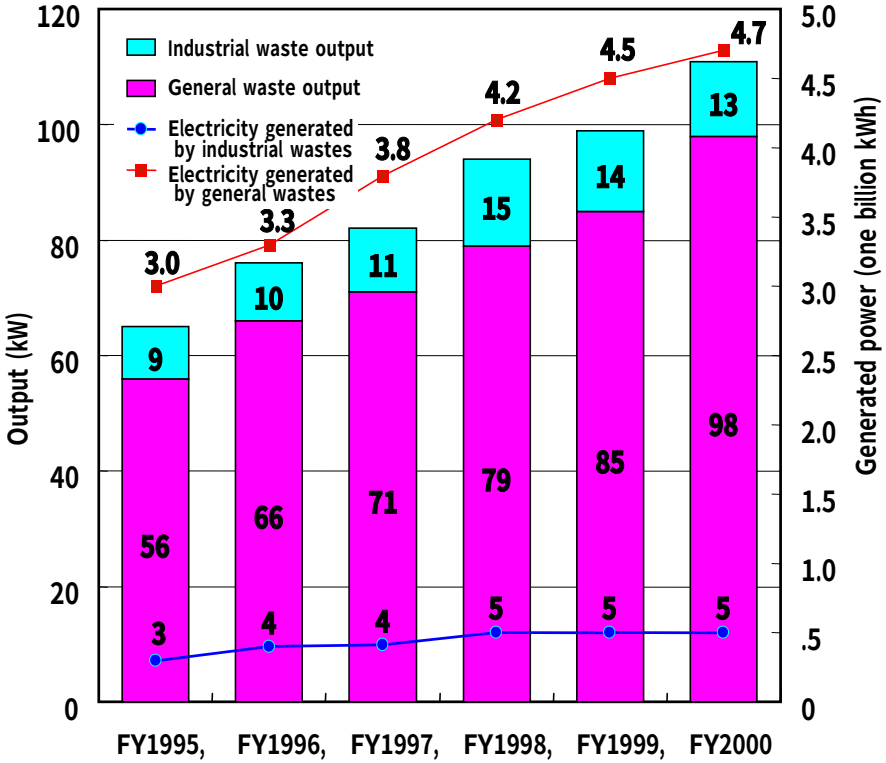
3,000,000 kW

What is waste power generation?

It is a system in which the energy generated when "wastes" are incinerated is used for power generation. It can be used for the use of energy in parallel.



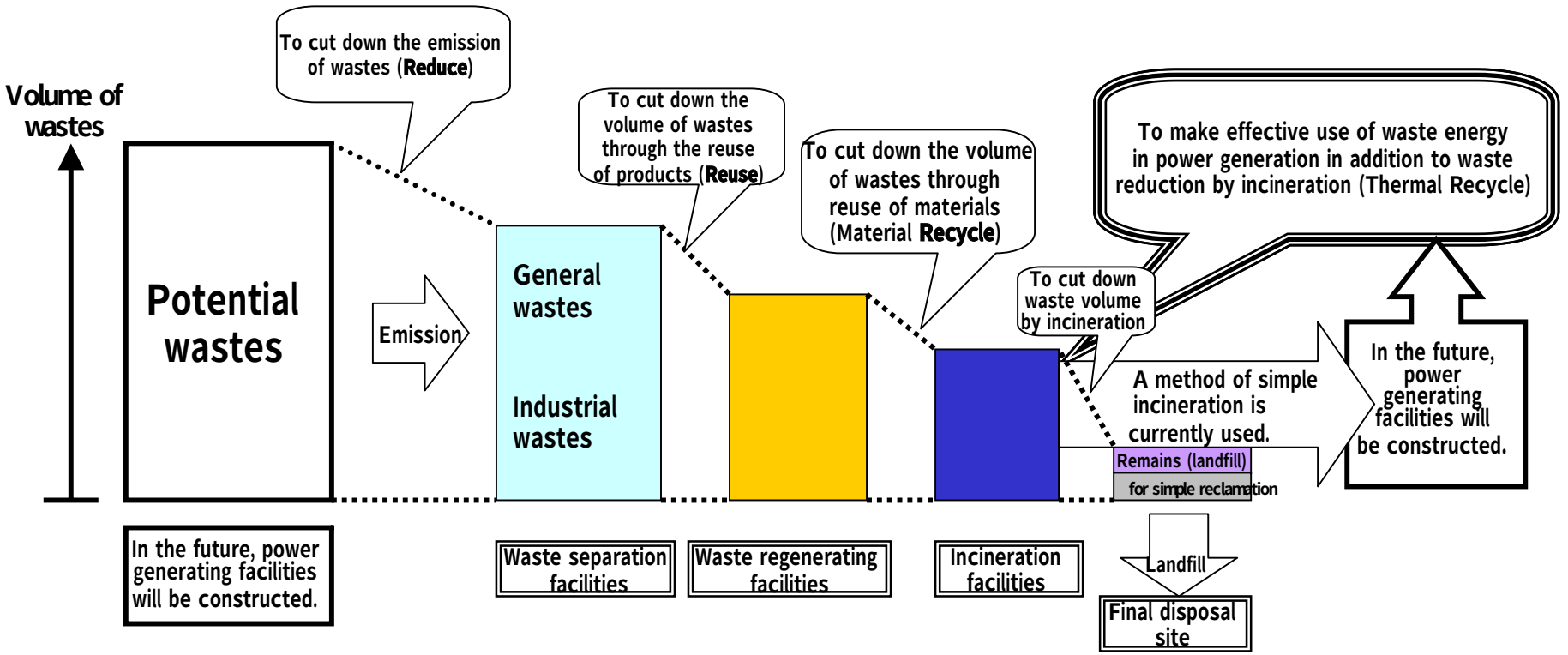
Transition of applications of waste power generation



Note 1) Industrial wastes include biomass but exclude wastes related to pulp and paper industries.

Note 2) The above figures do not include power generated by super-wastes.

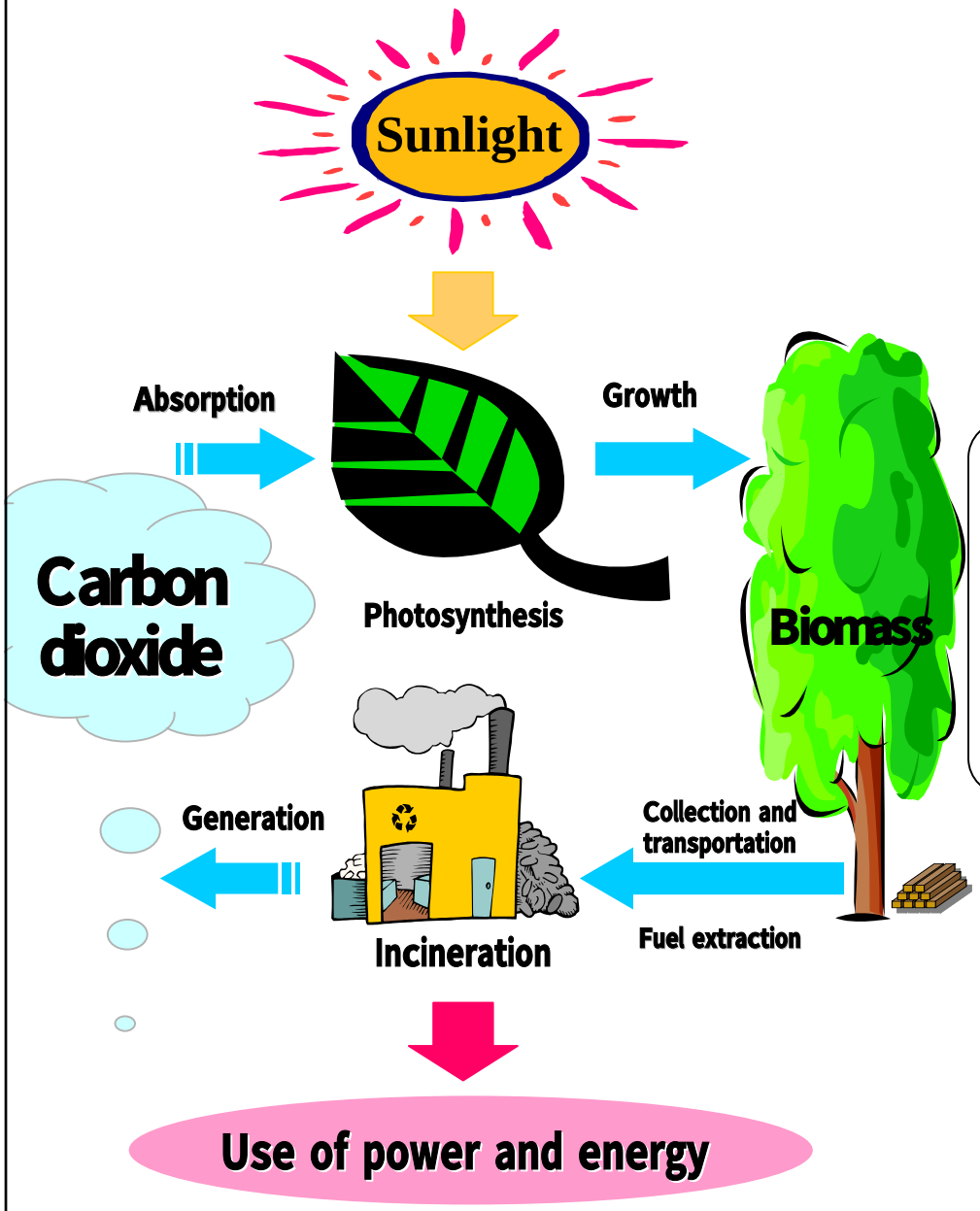
Concept of three R's and waste power generation in the Basic Law for Establishing the Recycling-based Society



<Background>
○ Applications of new energy from the perspective of global warming control measures
○ A serious scarcity of final disposal sites of wastes
○ Construction of a sound economy and society that carry less environmental load (Establishment of a recycling-based society)

Use of waste power generation

What is biomass energy?



What is biomass?

Biomass is constituted of organic matters stemming from plants and animals excluding fossil resources and is possible to be used as energy sources.

What is its significance as a form of energy ?

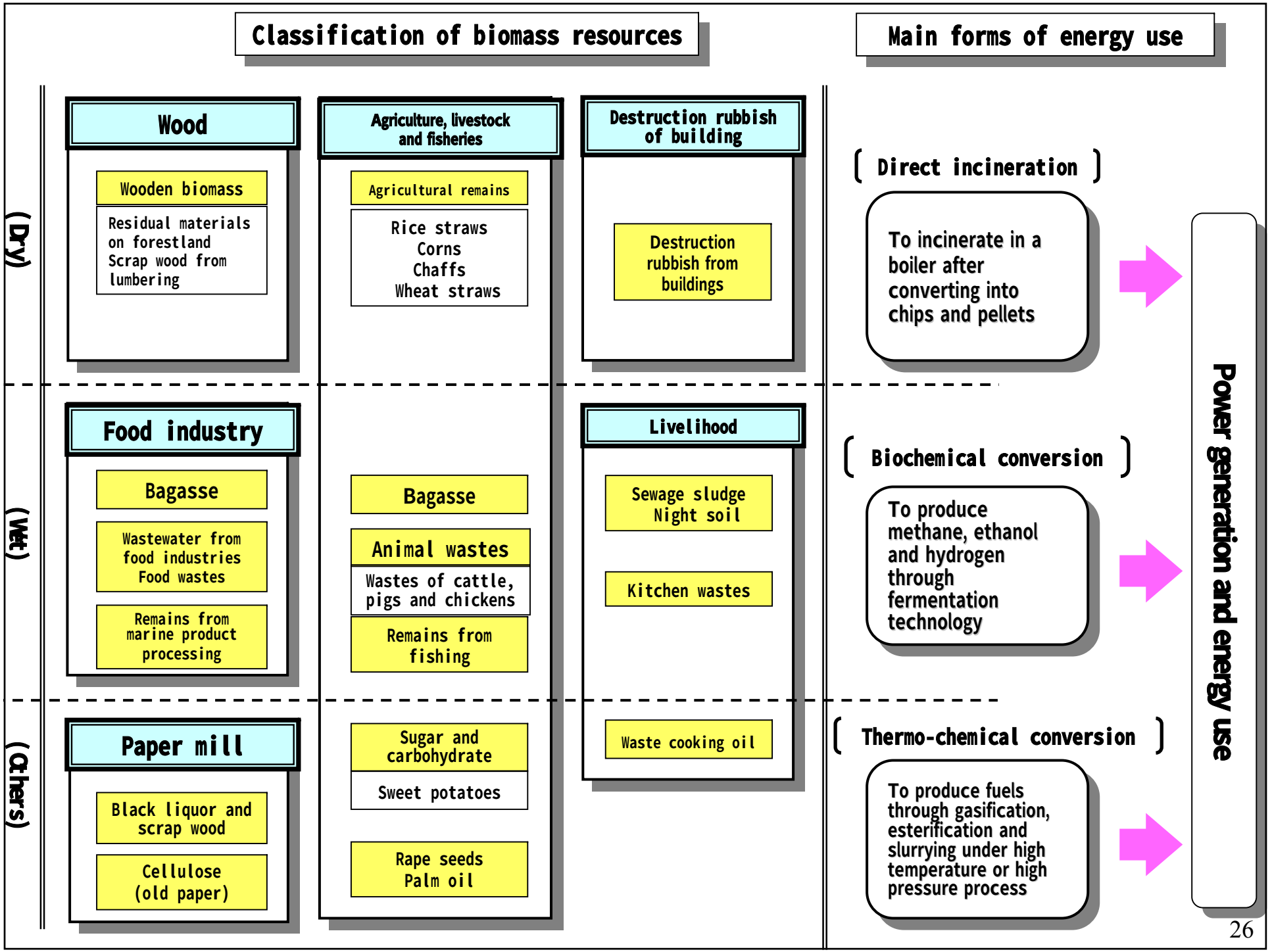
1 Biomass is “carbon neutral” and is recyclable energy. Additional Carbon Dioxide will not be emitted when utilized having considered the emitted Carbon Dioxide balance which is fixed by growing biomass at the same time.

2 Various energies will be available by reusing biomass that was left unutilized.

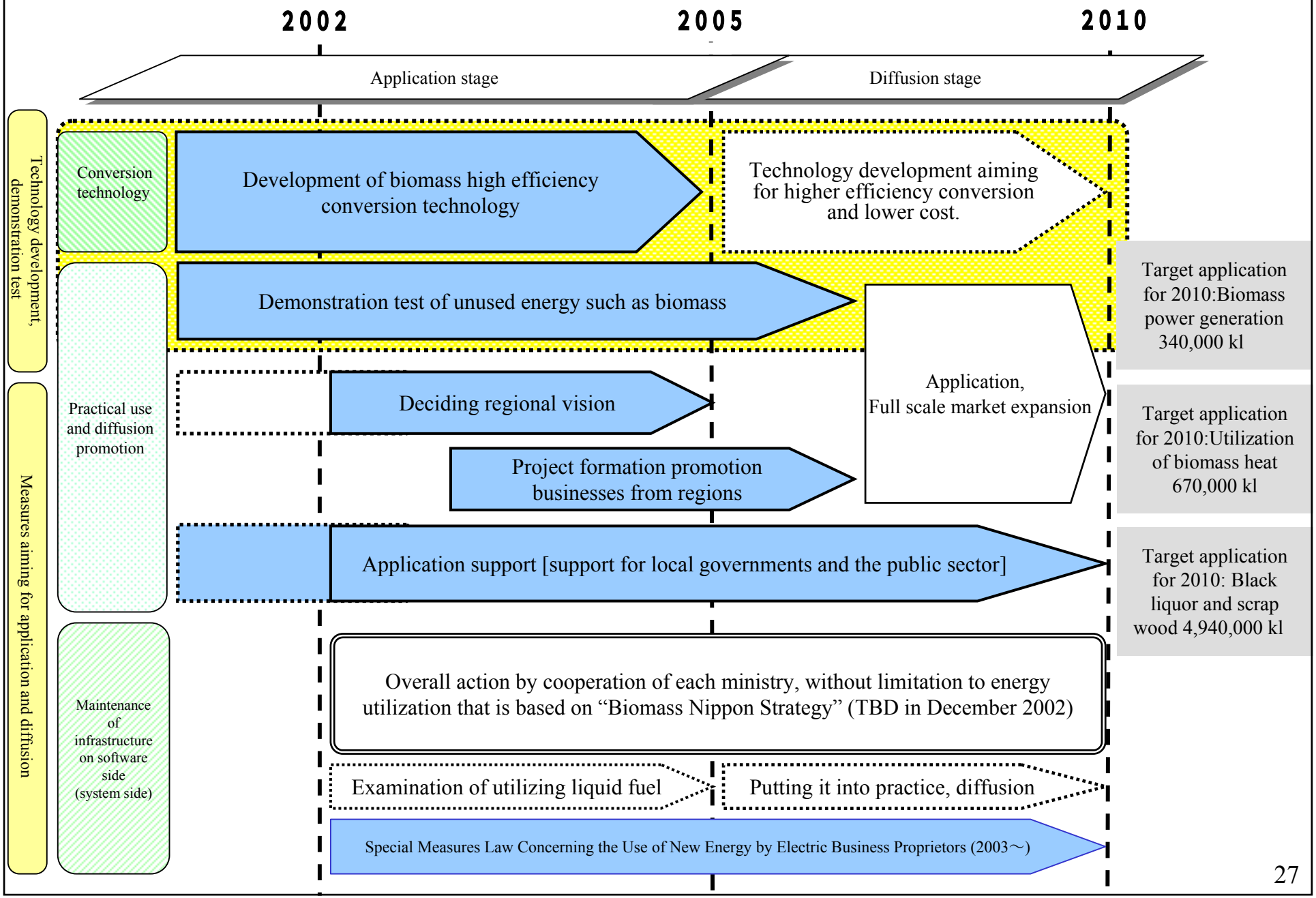
What are the problems to overcome?

1 Recovery and transportation of resources is a burden because of the low energy density per cubic volume and widespread area of the generation.

2 High efficiency by scale merit and lower cost are difficult because it tends to be a small dispersed facility.


Classification of biomass resources
Main forms of energy use
(Dry)
(Wet)
(Others)
Wood
Wooden biomass
Residual materials on forestland
Scrap wood from lumbering
Agriculture, livestock and fisheries
Agricultural remains
Rice straws
Corns
Chaffs
Wheat straws
Destruction rubbish of building
Destruction rubbish from buildings
Direct incineration
To incinerate in a boiler after converting into chips and pellets
Food industry
Bagasse
Wastewater from food industries
Food wastes
Remains from marine product processing
Bagasse
Animal wastes
Wastes of cattle, pigs and chickens
Remains from fishing
Livelihood
Sewage sludge
Night soil
Kitchen wastes
Biochemical conversion
To produce methane, ethanol and hydrogen through fermentation technology
Paper mill
Black liquor and scrap wood
Cellulose (old paper)
Sugar and carbohydrate
Sweet potatoes
Rape seeds
Palm oil
Waste cooking oil
Thermo-chemical conversion
To produce fuels through gasification, esterification and slurrying under high temperature or high pressure process
Power generation and energy use

Expanded Application of Biomass Energy Scenario

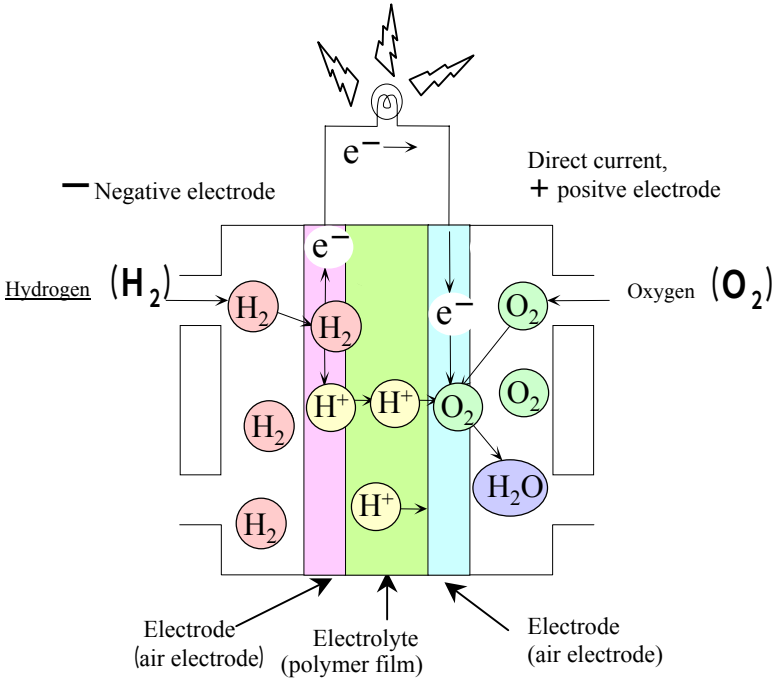


What is a Fuel Cell?

Principle of a fuel cell

A fuel cell generates power through a chemical reaction between hydrogen and oxygen.

$2H_2 + O_2 \rightarrow 2H_2O$ + Electricty + Heat

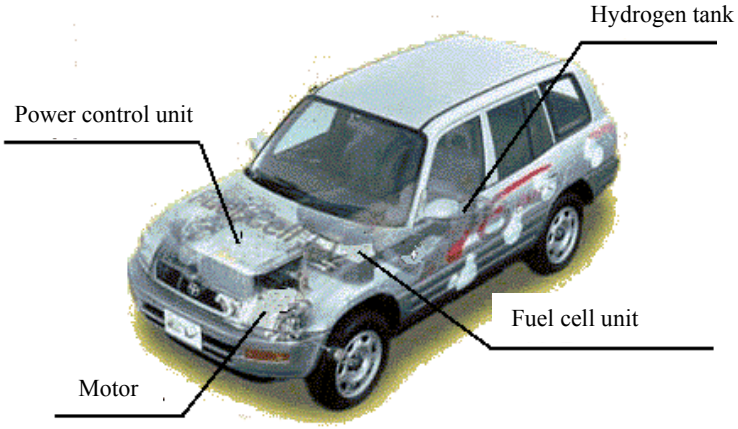


Charecteristics of fuel cells

1 Highly efficient power generation
2 Excellent environmental characteristics
3 Excellent quietness
4 Application to various systems by minituarizing

Application examples

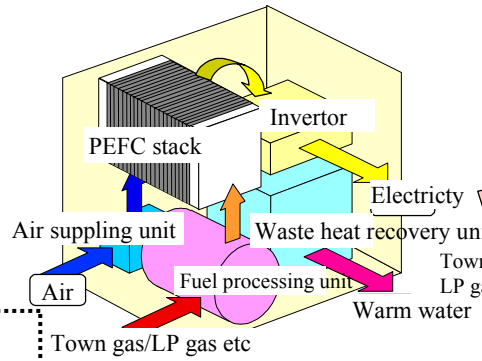
① *Fuel cell vehicles*



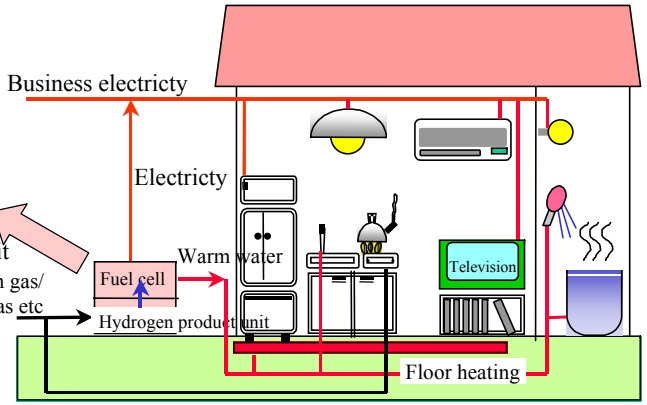
The ultimate car that is environmentally friendly

② *Fuel cell for household*

System composition example

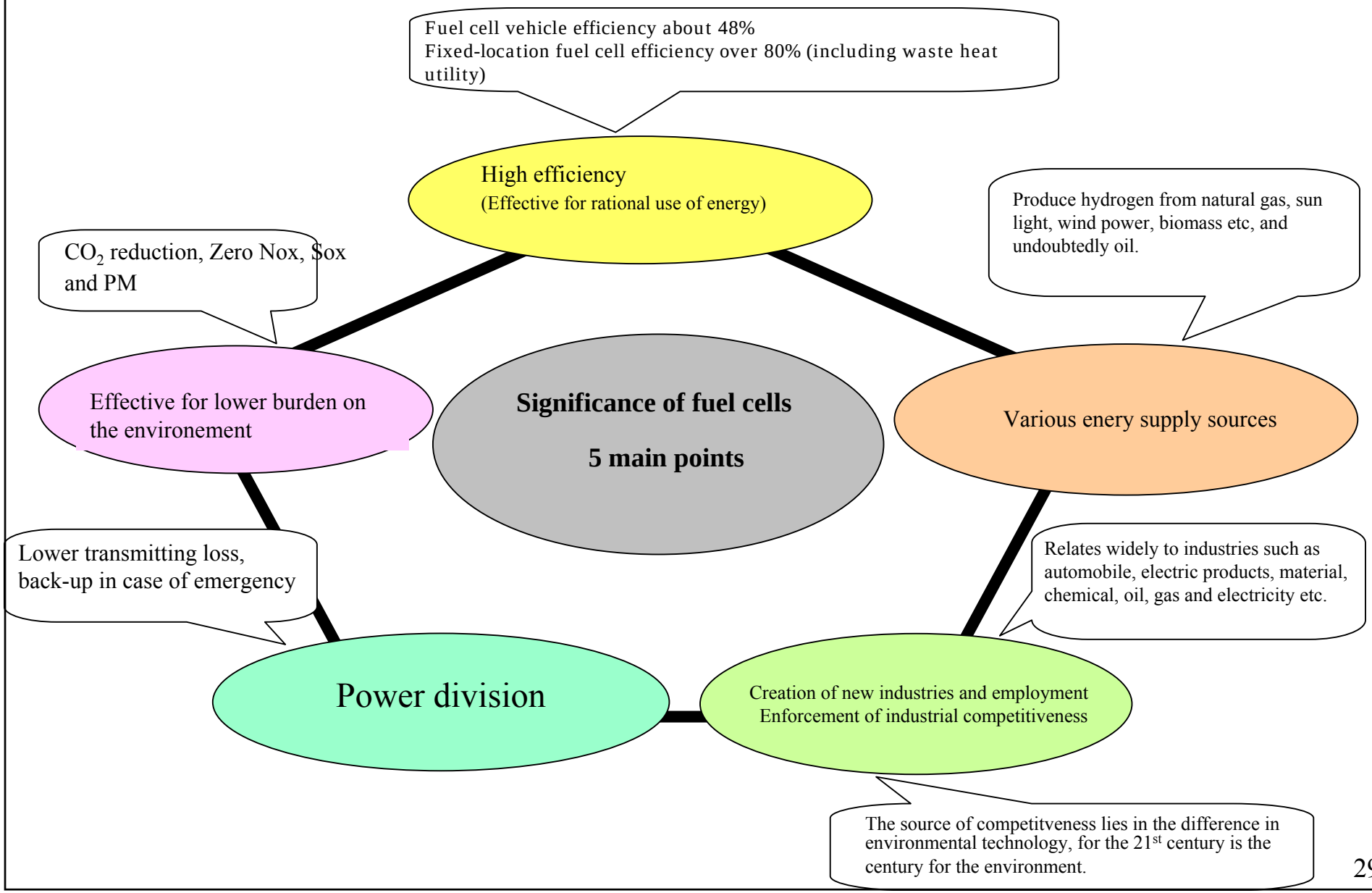


Installation image



Micro power revolution

Significance of a Fuel Cell



Development Trend of Fuel Cells-National & International (Fuel Cell Vehicles)

(1) Development trend of fuel cell vehicles

Company name	Year	
Toyota Motor Corporation	December 2002	Start of market sales test*
Honda Motor Co., Ltd	December 2002	Start of market sales test*
Nissan Motor Co., Ltd .	Within 2003 (TBD)	Start of market sales test*
General Motors Corporation	Around 2008-10	Start of full scale sales (several thousand units/year)
Daimler Chrysler Corporation	March 2003 (TBD) 2003 (TBD)	Start of fuel cell bus market sales test Start of fuel cell passenger cars market sales test
Ford Motor Company	2004 (TBD)	Start of market sales test

Note:
* Created based on information such as newspaper etc.
At this point, it is thought that the sales test is on the level of monitor business or demonstration business which means that it is a stage where technological problems will not happen.

(1)Demonstration project of fuel cell vehicles

Country/Town		Year	
U.S.A	Sacramento	2000 ~	California Fuel Cell Partnership (CaFCP) Passenger cars, buses to participate
	TBD	2003 ~	Project on Federal Government level Plan commercialization from 2015, start of public offering of vehicles (TBD) Plan to expand to several thousand units by 2008
Japan	Metropolitan area	2002~4	vehicles and buses that take part in test run at public roads by fuel cell vehicles including demonstration of hydrogen refueling station.
EU 8 countries	10 cities*	2003~	CUTE (Clean Energy Patnership) & ECTOS (Ecological City Transport System) Installation of hydrogen station at 10 cities and buses by Daimler Chrysler to participate.
Germany	Berlin	2003 ~	CEP (Clean Energy Partnership) Passenger vehicles (fuel cell automobiles and hydrogen engine cars) and fuel cell buses to participate.
Spain	Madrid	2003 ~	CITYCELL Buses from FIAT system to participate

*Stockholm (Sweden), London (U.K), Amsterdam (The Netherlands), Hamburg, Stuttgart, (Germany), Luxemburg (Luxemburg), Madrid, Barcelona (Spain), Porto (Portugal), Raykjavik (Iceland)

Development Trend of Fuel Cells-National & International (Fixed-location fuel cell)

(2) Development trend of fixed-location fuel cells

Company name	Year	
Toshiba International Fuel Cells Corporation	2000 2001 2002 2004~2005	1kW and 30kW fixed protocol unit development 1kW fixed field test 10kW business protocol unit development 5kW business protocol unit development 1kW.5kW put into practice
Sanyo Electric Co., Ltd	1998 2004 2005	1kW hydrogen gas cylinder method for portable development 1kW test sales start 1kW full scale sales
Ebara Ballard	2000 2003 2004	250kW grade system demonstration test Hydrogen gas cylinder method, 1kW grade commercialized 1kW for household commercialized
Matsushita Electric Industrial Co., Ltd	1999 2004	Laboratory test start with demonstration conditions 1kW cogeneration commercialized
Matsushita Electric Works, Ltd	2001 2004	250kw, portable power generation unit test sales 1kW, LNG cogeneration
Mitsubishi Heavy Industries, Ltd	2005	1kW commercialized
Nippon Oil Corporation	2002 2003 2004	5kW, oil system demonstration test 1kW,LP gas version monitor test start With Nippon Oil, 1kW, LP gas version put into practice
Cosmo Co. Ltd	2003	1~10kW level of putting into practice oil system fuel
Corona	2003	1~3kW putting into practice kerosene
Idemitsu Kousan	2004 2005	Putting LP gas into practice Level of putting into practice kerosene
Tokyo Gas Corporation	2004	Putting into practice town gas 1kW grade
Osaka Gas Corporation	2003 2005	0.5~1kW real operational test start 0.5~1kW for household commercialized
Plug Power	2001 2004	5kW grade field test 5kW grade sales start *Plug power purchased H-Power in November 2002
H-Power	2001 2003 2005	3~4.5 grade development 500W commercialized* 3-4.5 grade supply plan* *Currently on hold
Ballard Generation Systems	2004~2004 2002	250kW grade field test unit production, test Hydrogen gas cylinder method, 1kW commercialized
Toyota Motor Corporation	2004~2005 2008	Model housing construction Gasoline, housing full scale sales

Outline of Budget Related to Fuel Cell for FY2003

Budget got FY2003=30.7 billion Yen (Budget for FY2002 was 22 billion Yen)

[Main Budget]

(1)Polymer electrolyte fuel cell system technology development (5.3 billion Yen → 5.11 billion Yen)
Development of each element technology comprising a fuel cell, material technology and system technology, mass-production technology and lower-cost technology.

(2)Foundation technology development such as hydrogen safety utility [new] (0 → 4.55 billion Yen)
To secure safety technology such as obtaining data necessary for examining hydrogen safety and development of related devices such as a compression device necessary for hydrogen fuel infrastructure.

(3) Polymer electrolyte fuel cell system demonstration research(2.5 billion Yen → 3.86 billion Yen)
Fuel cell vehicles' public road test run including fuel refueling station demonstration, operation test under real utility condition with fixed-location fuel cell cogeneration system.

(4) Polymer electrolyte fuel cell system diffusion basis maintenance business(3.1 billion Yen → 3.87 billion Yen)
Various data collection through evaluation test, securing evaluation test method, proposing standards and standard plans. (Millennium Project)

(5)Lithium battery technology development for fuel cell automotive(1 billion Yen → 1.95 billion Yen)
Development of a lithium battery with high performance and long life, which has the highest efficiency among storage batteries

(6)Portable fuel cells technology development [new] (0 → 0.22 billion Yen)
Technology development of portable fuel cells aiming to put into practice after a few years.

(7)Fuel cell power generation technology development (3.3 billion Yen → 3.59 billion Yen)
Technology development of a solid oxide fuel cell (SOFC) and a molten carbonate fuel cell (MCFC), which have high generation efficiency.

Execution of Demonstration Research （Fuel cell vehicles ・Hydrogen supply infrastructure）

Execution system (FY2003)

Ministry of Economy, Trade and Industry

Supplementary: Fuel cell vehicles

Japan Electric Vehicle Association

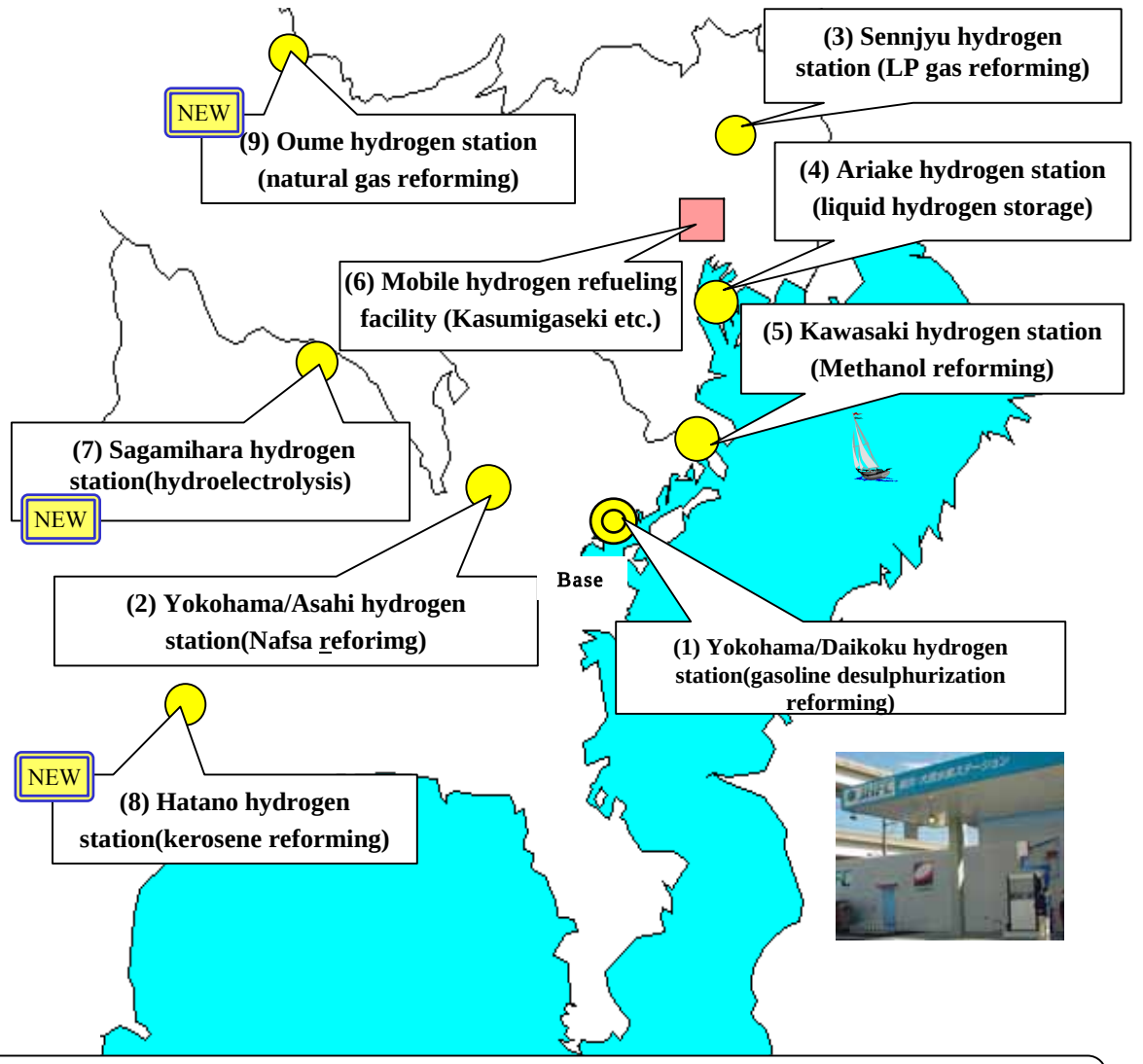
General Motors Corporation
Daimler Chrysler Corporation
Toyota Motor Corporation
Nissan Motor Co., Ltd
Honda Motor Co., Ltd
Japan Automobile Research Institute
NEW Suzuki Motor Corporation
NEW Hino Motors, Ltd
NEW Mitsubishi Motors Corporation

Hydrogen supply infrastructure demonstration relation

Engineering Advancement Association of Japan

(1) Cosmo Oil Co. Ltd
(2) Nippon Oil Corporation
(3) Tokyo Gas Corporation
Nippon Sanso Corporation
(4) Showa Shell Sekiyu K.K.
Iwatani International
(5) Japan Air Gases
(6) Nippon Sanso
NEW (7) Kurita Water Industries
NEW Sinanen Co. Ltd
Itochu Enex Co. Ltd
NEW (8) Idemitsu Kousan
NEW (9) Babcok Hitachi Co. Ltd
Nippon Steel Corporation

Hydrogen station situation status



Demonstration test contents ● Public test run of fuel cell vehicles
● Operation test of hydrogen refueling stations using various fuels etc.

Execution of Demonstration Research （Fixed-location fuel cells ）

H14FY	H15FY	H16FY
Operation at 12 places nationwide		
	Operation at 31 places nationwide	

Ministry of Economy, Trade and Industry

[Supplementary]

New Energy Foundation

Situation status (Osaka)

Situation status (Nagoya)

<Situation/operation testers>

Japan Gas Association=10 locations
Tokyo Electric Company, Ltd
Hokkaido Electric Company, Ltd
Hokuriku Electric Company, Ltd
Kansai Electric Company, Ltd
Chugoku Electric Company, Ltd
Fuel Cells
Kyushu Electric Company, Ltd
Kandenko Electric Company, Ltd
IF Solution
Yourtech
Idemitsu Kosan
Japan Energy Corporation
Taiyo Oil Co., Ltd
Sekisui Chemical Co., Ltd
Sinanen
Ebara Corporation
NTT Data Corporation
Tokiwa Shoji Co., Ltd
Matsumura Bussan Co., Ltd
House Japan
Nigata Prefecture
Gifu Prefecture
Muroran Techno Center

<System suppliers>

Ishkawajima-Harima Heavy Industries Co., Ltd
Ebara Corporation
Kurita Water Industries
Sanyo Electric Co., Ltd
Nippon Oil Corporation
Toshiba International Corporation
Toyota Motor Corporation
Hitachi Home and Life Solutions, Inc
Marubeni Corporation
Matsushita Electric Industrial Co., Ltd
Mitsubishi Heave Industries, Ltd

Demonstration test contents : ○ Operation test of fuel cell cogeneration system under various environments.
○ Effects evaluation test of fuel cells for households when systems are connected.

Rechecking of Regulation Related to Putting Fuel Cells into Practice

•○ Meeting members of related ministries concerning putting fuel cells into practice

Regarding examination request items from the industry, (Six Laws 28 Items), concerning "Meeting members of related ministries concerning putting fuel cells into practice", examination and schedule planning will be carried out presupposing secured safety.(October 25, 2002)

Rechecking of regulation schedule

Items to be executed by the end of FY2002, at the latest, so as not to cause any obstacles to the test market sales of fuel cell vehicles.(5 items)

After examination, confirmed no obstacles to test application

Items to be executed by the end of FY2004. This is when initial application of fuel cells on business level can be assumed. (23 items)

Creation of an example standard plan and obtaining experiment data centering the private sector by FY2003.

Regulating ministry side to confirm safety and execute measures necessary for technology standard maintenance within FY2004

Construct a regulation system assuming the application of fuel cells using hydrogen as energy, after 2005.

Six Laws

*1 High Pressure Gas Safety Law, Road Transportation Commercial Vehicle Law, Building Standard Law, Fire Law and Electricity Utilities Industry Law

*2 Meeting Members of Related Ministries
Cabinet Secretariat, Cabinet Office, National Police Agency, Fire and Disaster Management Agency, Ministry of Land, Infrastructure and Transport and Ministry of Environment

U.S.A and Japan's Measures Concerning Fuel Cells

Measures by U.S Federal Government

Bush Administration

Announces that the U.S will not participate the Kyoto Protocol

Approves oil development at Alaska

2002FY
75.5 million USD
(9.1 billion Yen)

Announces Freedom CAR Program (January 2002)
Revision of the program under the previous administration, technology development program related to vehicles

Holds Hydrogen Energy Roadmap Workshop (April 2002)
About 220 experts participated to adjust tasks in order to achieve the objective per field.

Hydrogen Energy Roadmap (November 12,2002)
Formulated measures to produce, store, and use hydrogen. (Hydrogen production from atomic power is one of the measures.)

2003 FY
97.4 million USD
(11,7 billion Yen)

The President announced a new program concerning hydrogen in his State of the Union Address (January 28, 2003)
Targets about 1.2 billion budget in 5 years.

2004FY request
165.5 million USD
(19.9 billion Yen)

(*1 Dollar=120 Yen)

2001
1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12.
2002
1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12.
2003
1. 2. 3. 4.

Measures by Japanese Government

Putting fuel Cells into Practice Strategy Research Report (January 22, 2001)
Scenario for diffusion of fuel cells by 2020.

Polymer Electrolyte Fuel Cell/Hydrogen Energy Utility technology Development Strategy (August 8 , 2001)

Trial Run of a Fuel Cell Vehicle by the Prime Minister, Related Ministers, Representatives of Parties (December 13, 2001)

In his policy speech, the Prime Minister mentions putting it into practice within 3 years. (February 4 2002)

Fuel Cell Project Team Report by Vice Minister (May 27, 2002)

Rechecking the path of comprehensive regulation for putting fuel cells into practice (October 25, 2002)

Leading Application of Fuel Cell Vehicles (December 2, 2002)

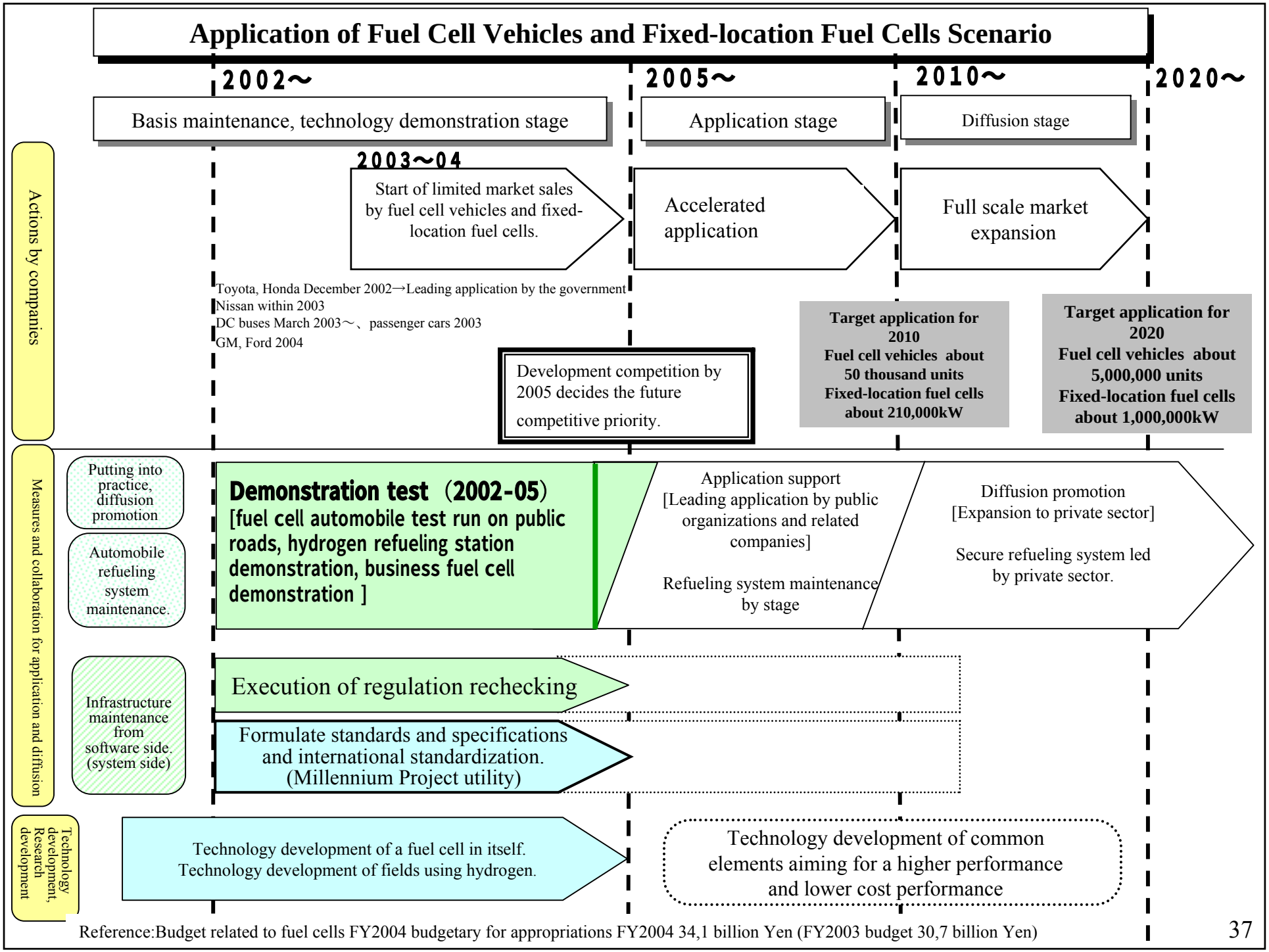
In his policy speech, the Prime Minister mentions rechecking of regulation and expanded diffusion of fuel cell vehicles. (January 31, 2003)

FY2001
11.9 billion Yen

FY2002
22 billion Yen

FY2003
30.7billion Yen

Application of Fuel Cell Vehicles and Fixed-location Fuel Cells Scenario



Reference:Budget related to fuel cells FY2004 budgetary for appropriations FY2004 34,1 billion Yen (FY2003 budget 30,7 billion Yen)