

# Energy Conservation Policies of Japan

IEA HPP WORKSHOP

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# **1. Summary of Energy Consumption**

2. Energy Conservation Law

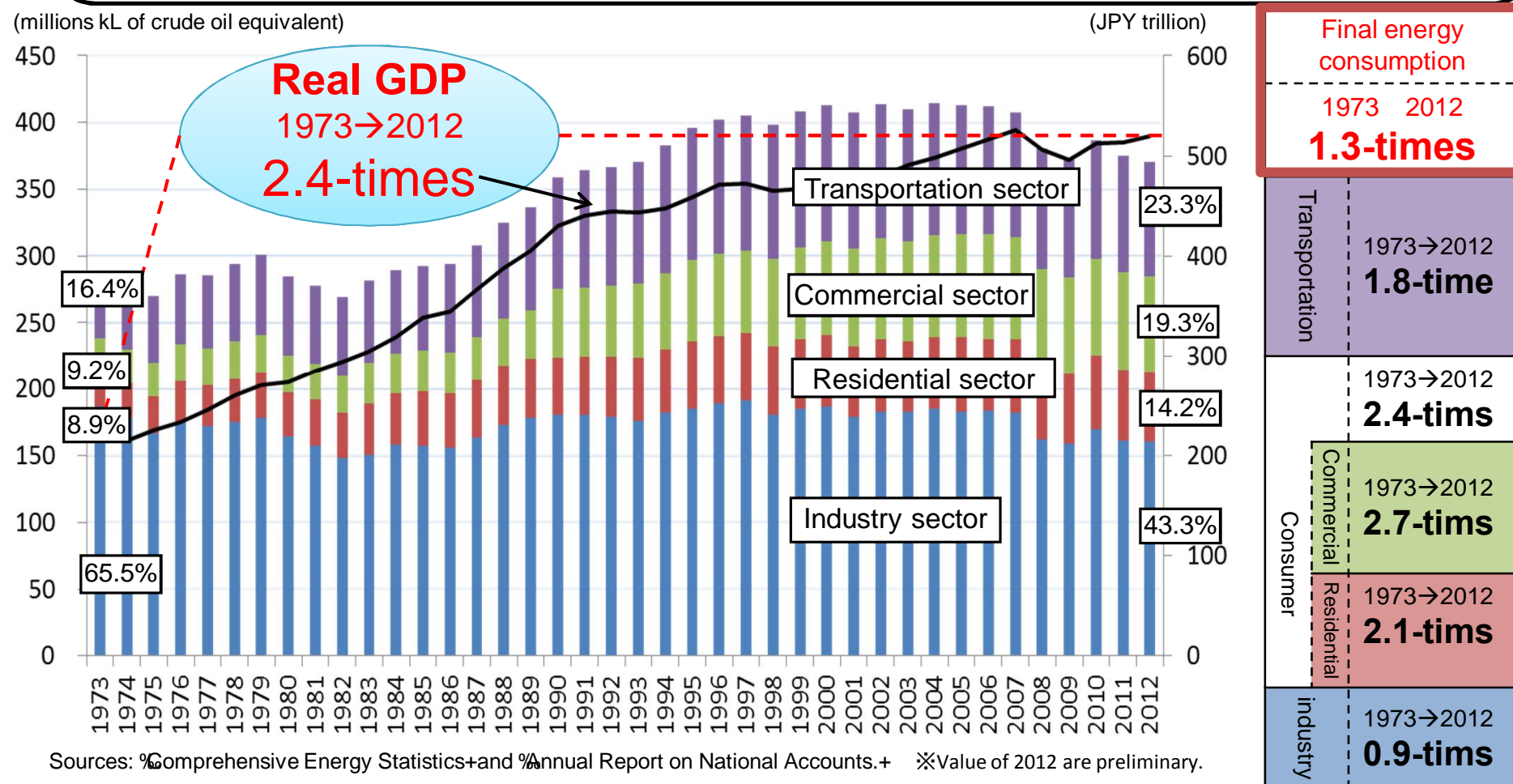
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# Trends in Final Energy Consumption in Japan

- The final energy consumption of Japan has basically consistently increased, except for periods immediately following the two oil crises and the recent economic downturn.
- Until 2012 the GDP continued increasing to about 2.4 times the 1973 level and the consumption of energy for individual sectors significantly increased with the Consumer sector increasing to **about 2.4 times**, while the transportation sector increased to **about 1.8 times**, whereas the industrial sector decreased to **about 0.9 times**.

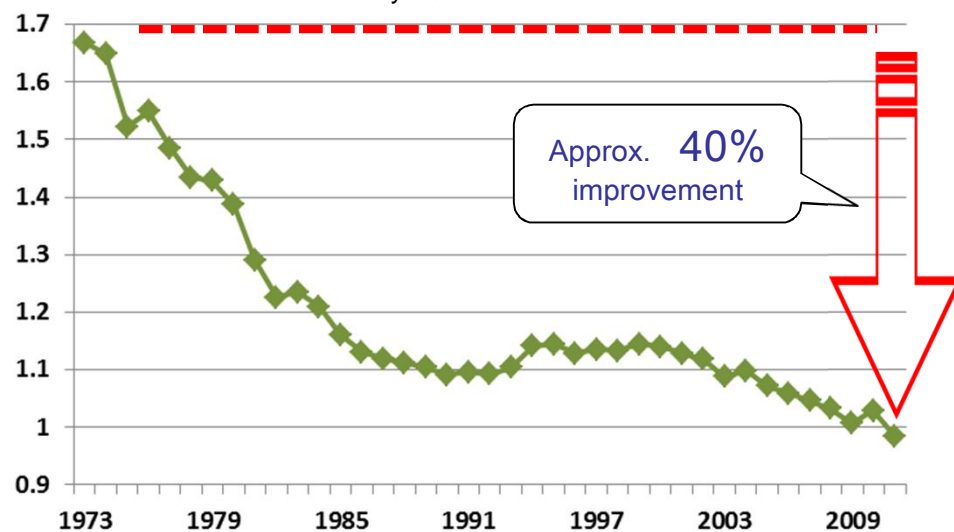


# Energy Conservation Efforts of Japan after Oil Crises

- Japan has improved energy efficiency by approx. 40% after the oil crises in the 1970s as a result of positive actions by both public and private industrial sectors.
- Japan intensively introduced "Energy Management System based on Energy Conservation Law", then achieved the lowest level of energy consumption per GDP in the world.

Primary energy use per real GDP of Japan

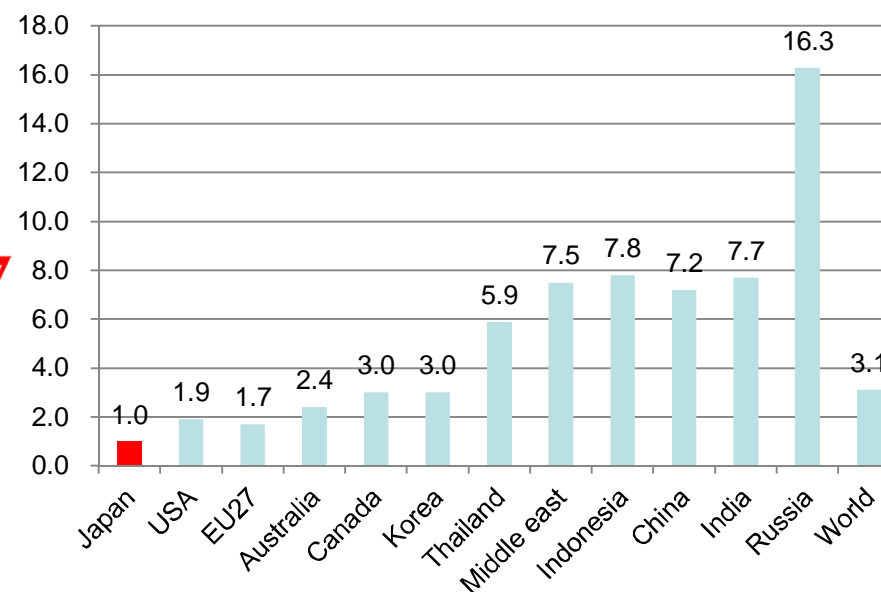
(Oil converted Mt / 1 trillion yen)



Source ) Total Energy Statistics by ANRE/METI

Primary energy supply per GDP unit of each country (2009)

(Index : Japan=1.0)



Calculated according to IEA statistics

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# Energy Conservation Law

- “Energy Conservation Law” was introduced in 1979 .
- The Law covers the energy consumption in industry, commercial & residential and transportation sectors.
- The Law specifies
  - 1) the framework which requires the business operators to annually measure and report their energy consumption to the Government,
  - 2) the energy efficiency standards for buildings and houses, and
  - 3) the “Top Runner program” which is applied to household appliances, equipment and automobiles.

	Industry sector	Consumer sector		Transportation sector
		Commercial sector	Residential sector	
Regulatory measures	<ul style="list-style-type: none"><li>✓ Annual reports to the Government by business operators with 1,500 or more kl/yr energy consumption</li><li>✓ 15,000 manufacturing plants &amp; offices</li><li>✓ Reduction efforts of 1% per year</li></ul>			<ul style="list-style-type: none"><li>✓ Periodic reports by freight carriers and consigners</li><li>✓ Reduction efforts of 1% per year</li></ul>
		<ul style="list-style-type: none"><li>✓ Energy efficiency standards for buildings and houses (300m<sup>2</sup> or more)</li></ul>		
			<ul style="list-style-type: none"><li>✓ Top runner standards for household appliances , equipment, automobiles etc., 28 items in total (Account for about 70% of household energy consumption)</li></ul>	

# Current Regulatory Scheme at Manufacturing Plants, etc.

- Business operators with overall annual energy consumption (head office, manufacturing plants, branch offices, sales offices, etc.) of **at least 1,500kl** in crude oil equivalent are subject to regulations.
- Business modes, such as franchised chains of stores, are also considered single business operators and those consuming at least 1,500kl for the whole chain are subject to regulations.



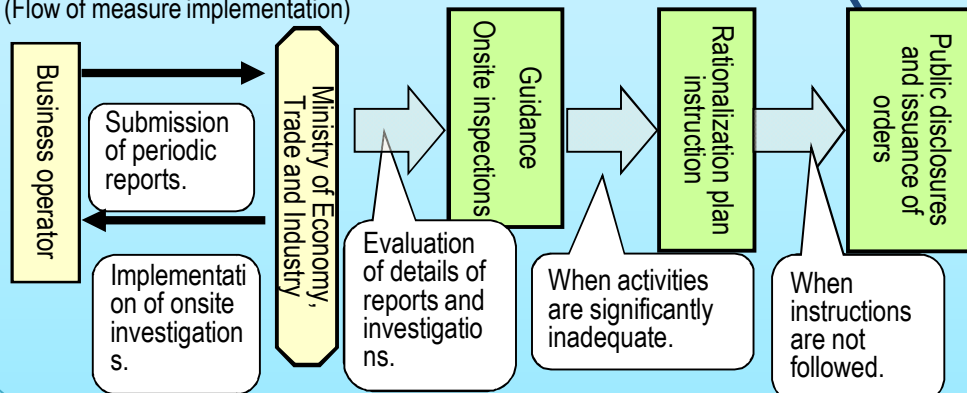
**On the basis of energy consumption, about 90% of the industry sector and about 40% of the commercial sector are covered subject to regulations.**

## ○ Obligation to report periodically

- ① Transition of energy unit consumption
- ② Status of activities relating to energy conserving measures
- ③ Obligation to annually report on status of benchmark indices (for subject business lines only), etc.

Measures, such as instructions, public notices and orders (fines in case of violation against orders) implemented when energy conservation activities of a business operator are significantly inadequate.

(Flow of measure implementation)



## ○ Numerical targets: **Reduction of annual average by at least 1%.**

## ○ **Guidelines** pertaining to energy conservation measures:

Stipulation of standards (guidelines) based on the Energy Conservation Law as observance items for energy management.

### ➤ Energy conservation measures for business operators overall

- Maintenance of energy management organization.
- Allocation of persons in charge.
- Formulation of policies for activities pertaining to energy conservation targets, etc.

### ➤ Energy conservation measures at individual manufacturing plants and business establishments (Example: Air conditioning systems.)

Preparation and implementation of management standards (manuals) pertaining to the following measures:

- Operational management (operating time, set temperature, etc.).
- Periodical measurement and recording of temperature, humidity, etc.
- Periodical maintenance and inspection of facilities.

## ○ **New numerical targets to include in addition to existing targets**

**Benchmark indices and standards to be targeted**

**Currently set business lines: Iron and steel, electric power, cement, paper manufacturing, petroleum refining and chemical.**

**Standards to be aimed for:** Levels satisfied by most superior business operators in respective industries (10 to 20%).

\* Fines imposed when orders are not followed.



# Top Runner Program

- The Top Runner Program is a mandatory program for companies (manufacturers and importers), to fulfill the efficiency targets within 3 to 10 years, which encourages competition and innovation among the companies without increasing market prices.
- Companies make efforts toward those goals, so the program has contributed to improving energy efficiency of consumer electronics and automobiles in Japan.
- For instance, we had expected energy efficiency improvements of 16.0km/L for medium class gasoline passenger vehicles in fiscal year 1999, but actually, it attained 19.9km/L.

## Achievement of Top Runner Program



### Gasoline passenger vehicles

**48.8%** (FY1995→FY2010)



### Air-conditioners

(Types other than direct airflow & wall-mount)

**32.3%** (FY1997→FY2007)



### Electric refrigerators

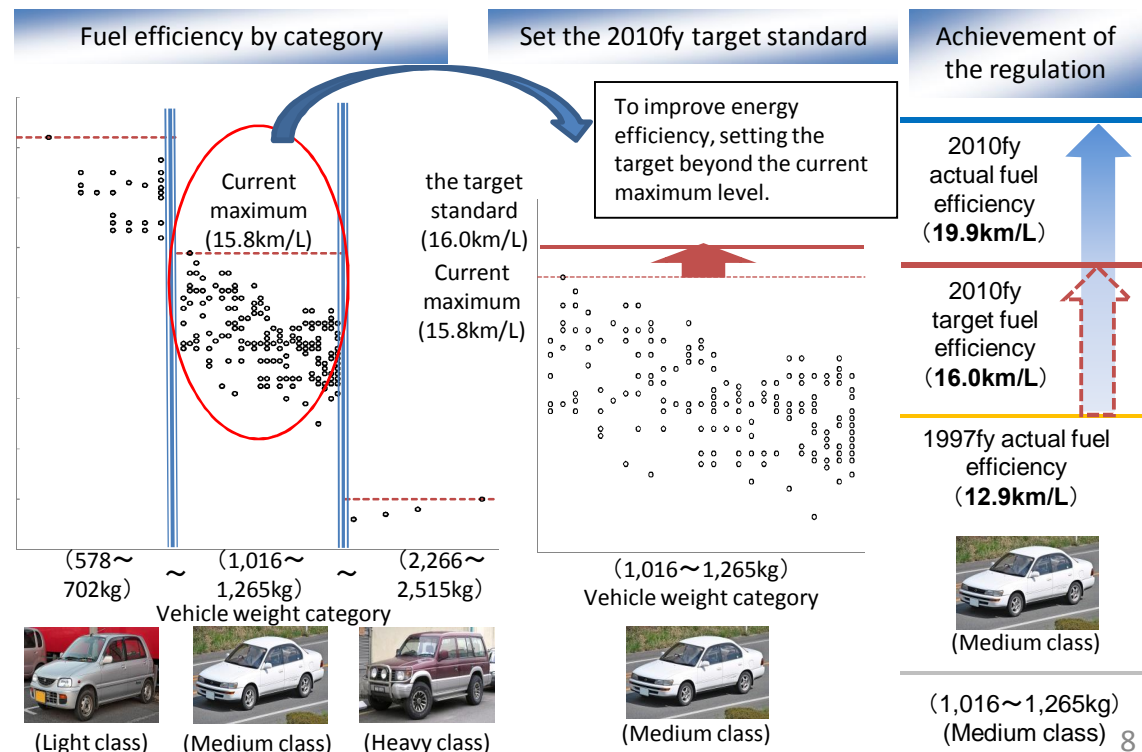
**43.0%** (FY2005→FY2010)



### TV sets (LCD and PDP TVs)

**29.6%** (FY2004→FY2008)

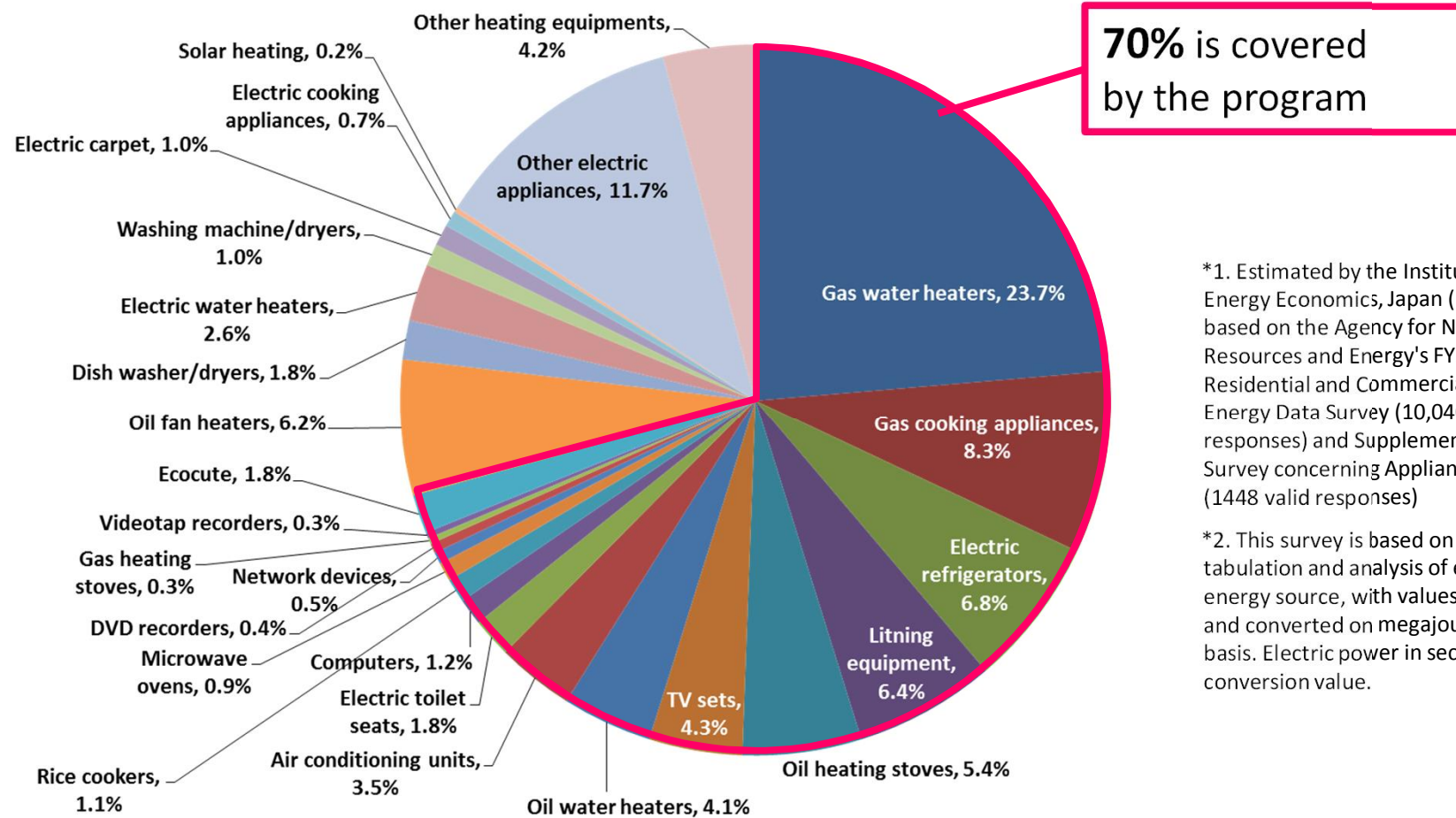
## Basic mechanism of Top Runner Program (The case of gasoline passenger vehicles)



# Appliances & Equipment covered by the Top Runner Program

- “Top Runner Program” is implemented in about 70% of the energy consumption in households.

**2009, Energy consumption level per household  
34,905MJ/Year**

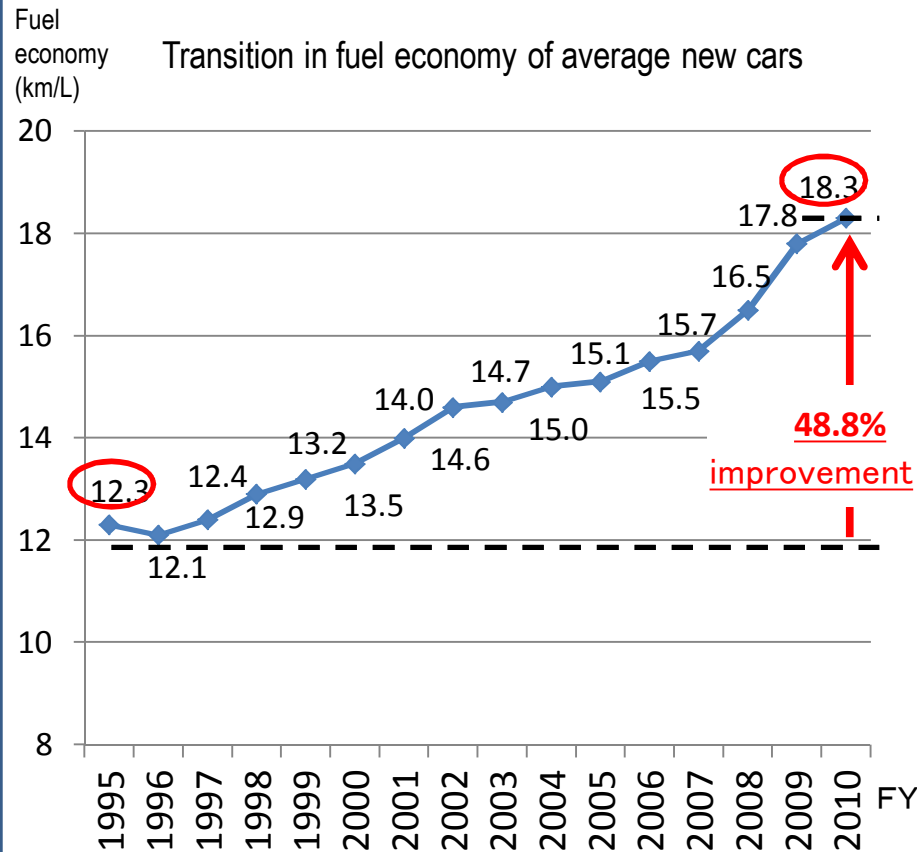


\*1. Estimated by the Institute of Energy Economics, Japan (IEEJ), based on the Agency for Natural Resources and Energy's FY2009 Residential and Commercial Sector Energy Data Survey (10,040 valid responses) and Supplementary Survey concerning Appliance Use(?) (1448 valid responses)

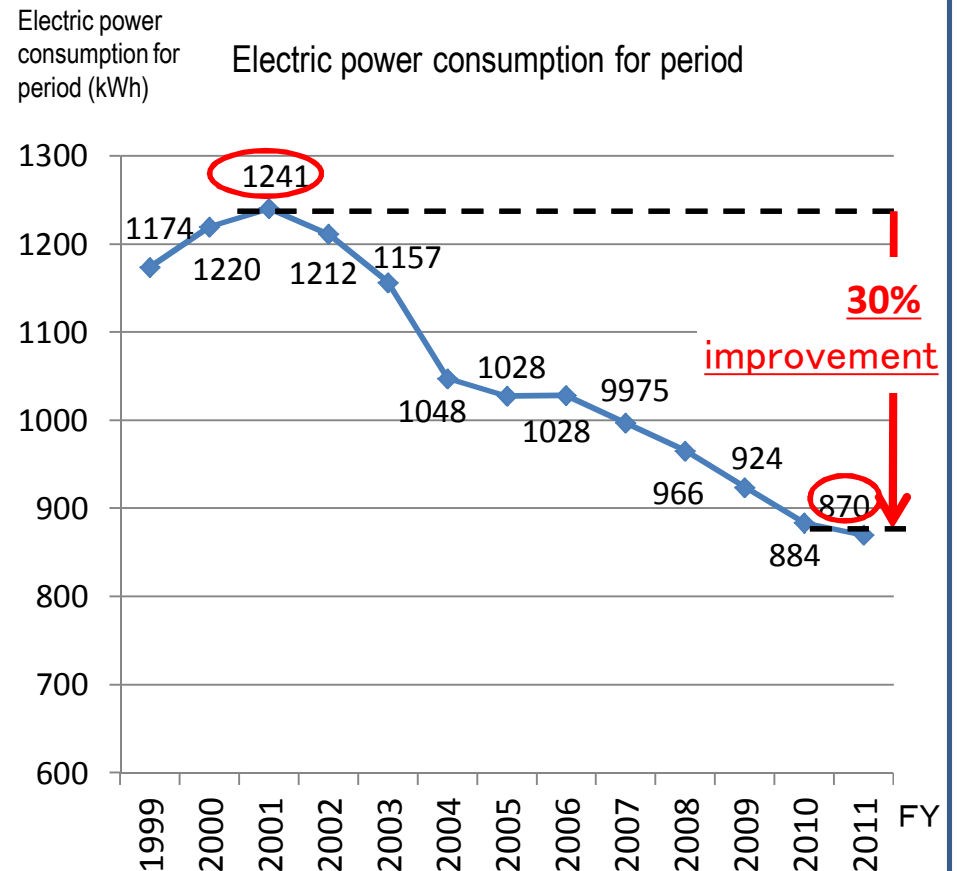
\*2. This survey is based on tabulation and analysis of each energy source, with values unified and converted on megajoule (MJ) basis. Electric power in secondary conversion value.

# Improvements in Energy-Efficiency with Top Runner Program (1)

## [Passenger cars]



## [Air conditioners]



# Improvements in Energy-Efficiency with Top Runner Program(2)

Product name	Improvement in energy efficiency (performance data)	Breakdown
Air conditioning units (room air conditioners)	67.8% (FY1997 2004 (industry fiscal year)) 16.3% (FY2005 2010) (4.0kW or less ) 15.6% (FY2006 2010) (4.0kW greater)	COP (3.01 5.05) APF (4.9 6.7) APF (4.5 5.2)
Electric refrigerators	55.2% (FY1998 2004) 43.0% (FY2005 2010)	Annual power consumption (647.3kWh/year 290.3kWh/year) Annual power consumption (572kWh/year 326kWh/year)
Electric freezers	29.6% (FY1998 2004) 24.9% (FY2005 2010)	Annual power consumption (523.8kWh/year 369.7kWh/year) Annual power consumption (482kWh/year 362kWh/year)
Gasoline-engine passenger cars	48.8% (FY1995 2010)	Fuel efficiency (12.3km/l 18.3km/l)
Diesel-engine freight vehicles	21.7% (FY1995 2005)	Fuel efficiency (13.8km/l 16.8km/l)
Vending machines	37.3% (FY2000 2005)	Annual power consumption (2617kWh/year 1642kWh/year)
Fluorescent lighting	35.7% (FY1997 2005)	Lumen/watt (63.1lm/W 85.6lm/W)
Computers	99.1% (FY1997 2005) 80.8% (FY2001 2007) 85.0% (FY2007 2011)	Watt/mega calculation (0.17 0.0015) Watt/mega calculation (0.012 0.0023) Watt/giga calculation (1.87 0.281)
Magnetic disc devices	98.2% (FY1997 2005) 85.7% (FY2001 2007) 75.9% (FY2007 2011)	Watt/gigabyte (1.4 0.0255) Watt/gigabyte (0.14 0.020) Watt/gigabyte (0.019 0.0045)
Copiers	72.5% (FY1997 2006)	Electric power consumption (155Wh 42.7Wh)
Electric toilet seats	14.6% (FY2000 2006)	Annual power consumption (281kWh/year 240kWh/year)
Gas water heaters (gas boilers & gas bath water heaters)	5.5% (FY2000 2006)	Thermal efficiency (77.7% 82.0%)
Oil water heaters	4.0% (FY2000 2006)	Thermal efficiency (82.0% 85.3%)
Gas cooking appliances (cooktop burners)	15.7% (FY2000 2006)	Thermal efficiency (48.3% 55.9%)

# Improvements in Energy-Efficiency with Top Runner Program(2)

Product name	Improvement in energy efficiency (performance data)	Breakdown
Gas heaters	1.9% (FY2000 2006)	Thermal efficiency (80.9% 82.4%)
Oil heaters	5.4% (FY2000 2006)	Thermal efficiency (78.5% 82.7%)
Television sets (LCD & plasma TV)	29.6% (FY2004 2008)	Annual power consumption (179.7kWh/year 126.5kWh/year)
Video tape recorders	73.6% (FY1997 2003)	Watt(4.55W 1.20W)
DVD recorders (noncompliant with terrestrial digital broadcasting)	40.9% (FY2004 2008)	Annual power consumption (66.0kWh/year 39.0kWh/year)
DVD recorders (with terrestrial digital broadcasting)	45.2% (FY2006 2010)	Annual power consumption (85.9kWh/year 47.1kWh/year)
Microwave ovens	10.5% (FY2004 2008)	Annual power consumption (77.2kWh/year 69.1kWh/year)
Electric rice cookers	16.7% (FY2003 2008)	Annual power consumption (119.2kWh/year 99.3kWh/year)
Transformers	13.1% (FY2003 2008)	Watt(818W 711W)
Routers	40.9% (FY2006 2011)	Watt(6.09W 3.60W)
Switching devices	53.8% (FY2006 2011)	Watt/gigabit/second (6.36W/Gbit/s 2.94W/Gbit/s)

# Equipment Added to Top Runner Program

## 1. The following equipment has been added to the program.

- Heat pump water heaters (electric)
  - Added to program in March 2013.
  - Target efficiency is 27% in 2017Fy.



- Commercial refrigerators/freezers
  - Added to program in March 2013.
  - Target efficiency is 22.7% in 2016Fy.



### Other items

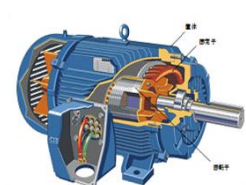
- Complex machines (Mar. 2013)
- Printers (Mar. 2013)
- Industrial motors (three-phase induction motors) (Nov. 2013)
- LED lamps (Nov. 2013)



Complex machines



Printers



Industrial motors



LED lamps

## 2. Equipment for which standards are currently under deliberation.

- Showcases



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### Energy Conservation Measures in Consumer Sector

#### Top Runner Program for Building Materials etc.

- ✓ Certain items that do not consume energy themselves but contribute to higher efficiency of energy consumption in housing, buildings, or other equipment will be added to the Top Runner program.

(Products currently subject to the program):  
28 products including passenger vehicles, air conditioners, TVs, Luminaires and refrigerators

(Newly added products (planned)):  
windows, heat insulating materials, etc.

### Peak Demand Reduction

#### Measures on demand side

- ✓ Consumers' efforts to reduce the use of electricity from utility grids during the peak demand hours will be able to evaluate.
  - \*For example, using storage batteries, energy management systems in buildings and households, private power generation etc.
- ✓ Specifically, the procedures to calculate the target of efforts under the Energy Conservation Law will be reviewed.

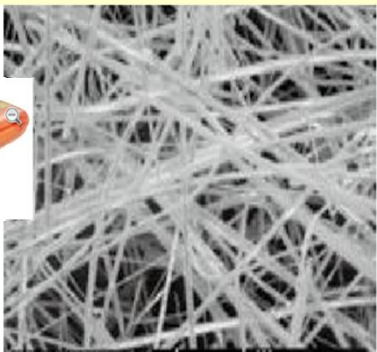


# Materials Covered by The New Top Runner Program

- Insulation used in envelopes+ and glass and frames used in windows+ are concluded to be covered by the new Top Runner Program (Oct. 2013).
- Details of coverage of insulation under the Building Material Top Runner Program were deliberated in line with this conclusion.
- Details of coverage of glass and frames used in windows under the new Top Runner Program are now under consideration.

## Insulation

Ordinary glass wool  
Avg. fiber diameter: 7-8  $\mu\text{m}$



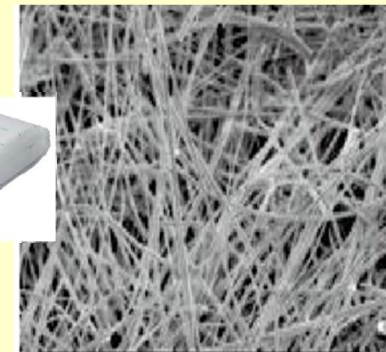
Thermal resistance:  
2.0 ( $\text{m}^2\text{K/W}$ )



- ◆ Market share: approx. 3%
- ◆ Approx. 40% better insulating performance than ordinary glass wool

High-performance glass wool  
(fine fibers)

Avg. fiber diameter: 4-5  $\mu\text{m}$



Thermal resistance:  
2.7 ( $\text{m}^2\text{K/W}$ )

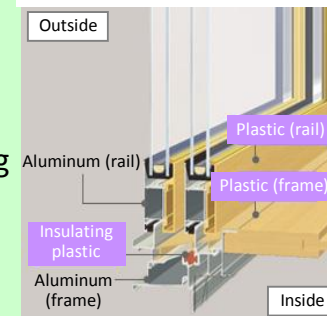
## Windows

Aluminum sash +  
single-pane glazing

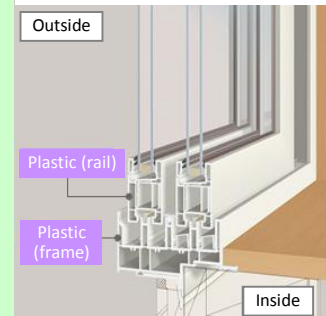


- ◆ Market share: approx. 3% to under 10%
- ◆ Approx. 100% better insulating performance than aluminum single-pane windows

Al-plastic composite sash  
+ low-E multilayer glazing



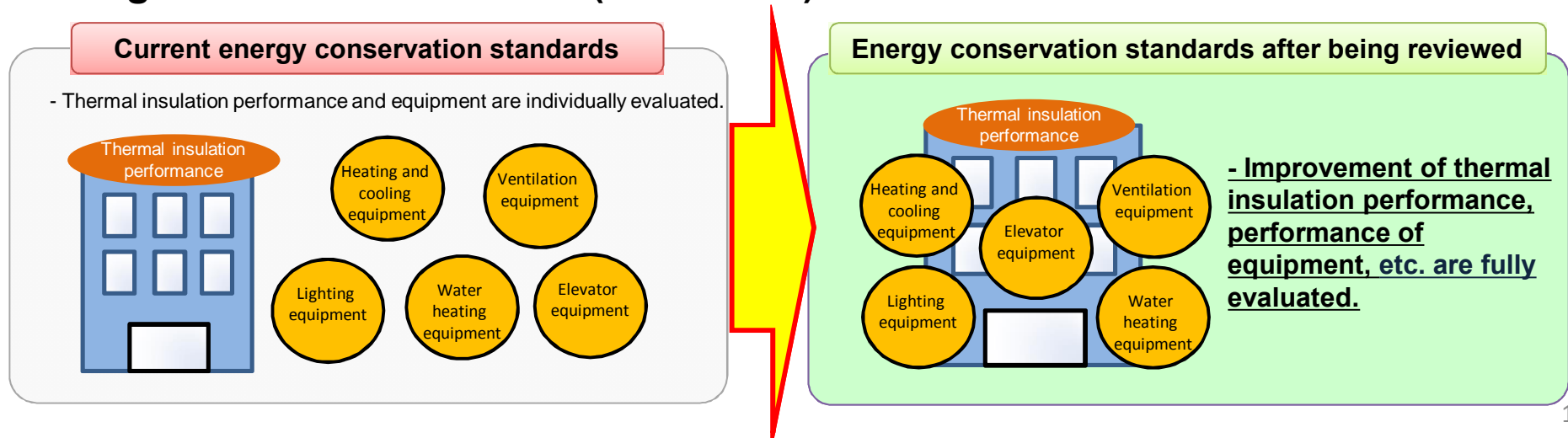
Plastic sash + low-E  
multilayer glazing



# Reviewed Energy Conservation Standards for Residential Buildings and Structures

- The review was executed for the first time in 13 years (since 1999 - to be publicized in the early part of December).
- For structures, the standards are changed from those which regulate the performance of thermal insulation+and individual building equipment (air conditioners, machine ventilators, lights, water heaters, elevators)+to **those using the primary energy index** which integrates the previous two elements.
- For residential buildings, the standards has change from those which quantitatively regulate thermal insulation+only to **those using the primary energy index** which integrates the building equipment.
- The standard value has become the level which can be achieved by introducing equipment whose performance is higher than that of the standard equipment currently available in the market.
- In addition to primary energy consumption, the **thermal insulation performance (standard level of 1999) must in principle be satisfied** for the purpose of reducing air conditioning load and securing heat.

## <Image of revised standards (structures)>



# Level of the Energy Conservation Standards after being Reviewed

- The energy conservation level was enhanced by approximately 15% to 25% by improving the performance of equipment.

## Structures: Estimation of offices in 6 areas (old IVb area (Tokyo)) (\*)

Equivalent to 1999 standards	External cover: Urethane foam spray 20 mm
	Air conditioning: CEC/AC = 1.5
	Ventilation: CEC/V = 1.0
	Lighting: CEC/L = 1.0
	Water heating: CEC/HW = 1.5
	Elevator: CEC/EV = 1.0

1.80 GJ/m<sup>2</sup>/year

7.4% reduction

After reviewing	External cover: Stainless foam board (extrusion) 25 mm
	Air conditioning: CEC/AC = 1.5
	Ventilation: CEC/V = 0.68
	Lighting: CEC/L = 0.82
	Water heating: CEC/HW = 1.5
	Elevator: CEC/EV = 1.0

1.67 GJ/m<sup>2</sup>/year

\* Estimation based on energy consumption ratio of each piece of equipment described in %FY2002, Research on energy consumption of buildings+

## Residential buildings: Estimation of 120m<sup>2</sup> living rooms operated intermittently in 6 areas (old IVb area (Tokyo)) (\*)

Equivalent to 1999 standards	External cover: Equivalent to 1999 standards
	Air conditioning: Air conditioning COP (LDK heating: 2.2, cooling: 1.9)
	Ventilation: SFP (1.0)
	Lighting: Incandescent lamps are used in part.
	Water heating: Gas instantaneous type (conventional type)

80.1 GJ/year

26.3% reduction

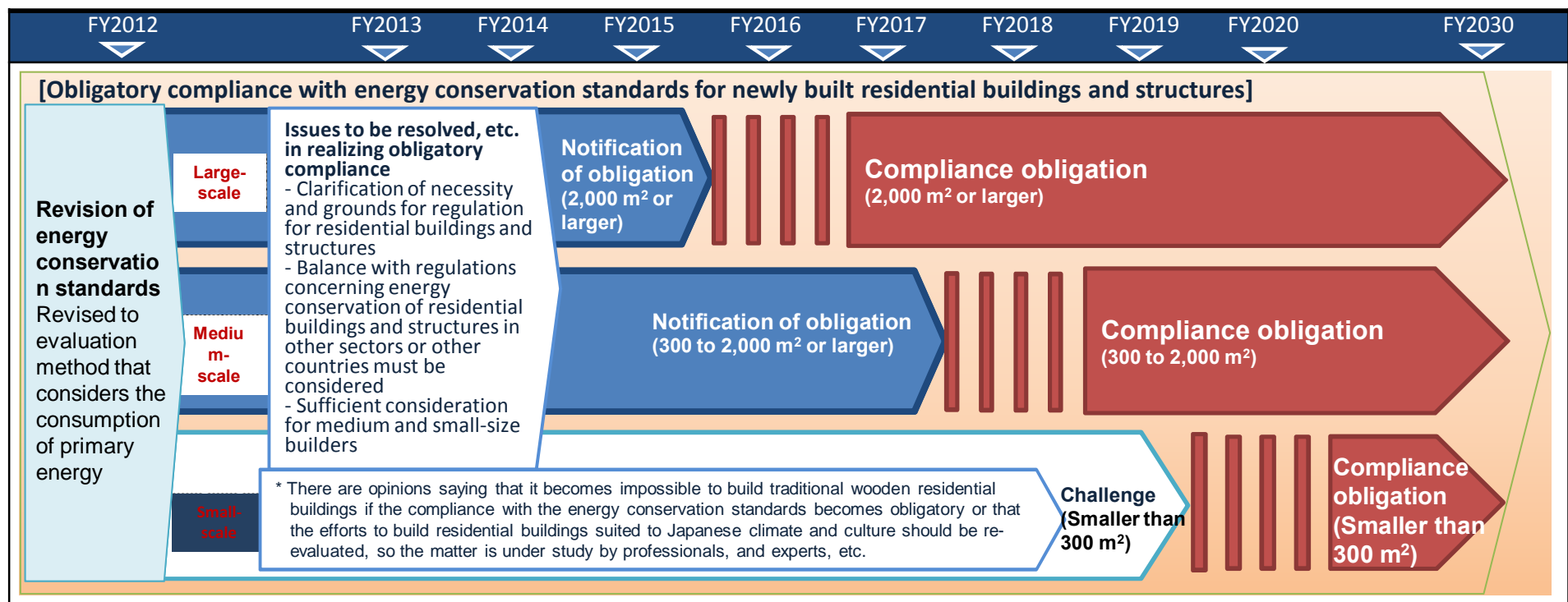
After reviewing	External cover: Equivalent to 1999 standards
	Air conditioning: Air conditioning COP (LDK heating: 4.0, cooling: 3.0)
	Ventilation: SFP (0.3)
	Lighting: Incandescent lamps are used in part.
	Water heating: Gas instantaneous type (conventional type)

59.0 GJ/year

\* Value excluding other energy consumption (approx. 21 GJ/year) set by the standard after being reviewed.

# Obligatory Compliance with Energy Conservation Standards for Residential Buildings and Structures

- Meeting for Promoting Houses and Living for Low Carbon Society+(Ministry of Economy, Trade and Industry, Ministry of Environment and Ministry of Land, Infrastructure, Transport and Tourism) publicized %Interim Report+and %Process Schedule+on July 10 in 2012.
- The compliance with the energy conservation standards for residential buildings and structures is to be obligatory by 2020 in steps, i.e. in the order of large-scale structures, medium-scale structures and small-scale structures, considering the following issues.



**[Enrichment of measures for new construction]** Support for zero energy residential buildings/support for residential buildings and structures as CO<sub>2</sub> saving model/certification of and support for low carbon residential buildings and structures, etc.

**[Strengthening of existing, stock measures]** Support for energy conservation reform of currently-existing residential buildings and structures/improvement of the performance of building materials and equipment using the Top Runner Program for building materials and equipment, etc.

**[Human development, etc.]** Support for medium and small-scale builders and carpenters trying to master energy conservation construction techniques (5 years from 2012 to 2016)/review of evaluation method for traditional wooden residential buildings, etc.

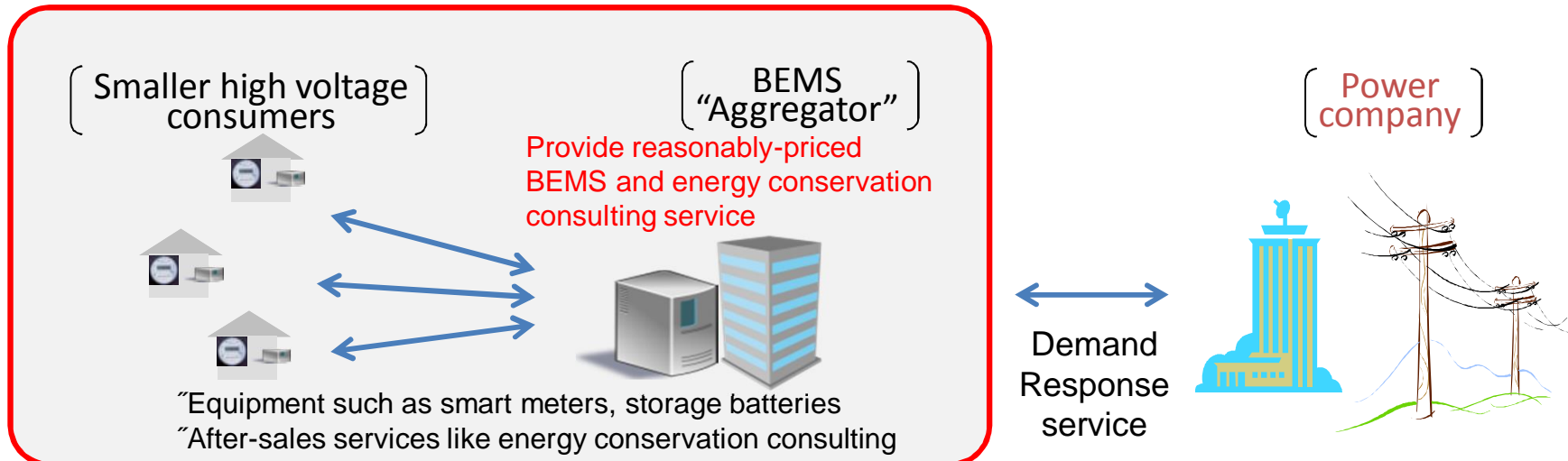
\* Excerpt and summary of the article entitled %process chart for promoting the houses and the way of living aiming to realize a low carbon society+in the paper entitled %the interim report on the promotion of the houses and the way of living aiming to realize a low carbon society+(July 10, 2012).

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# Promote introduction of Energy Management Systems (BEMS and HEMS)

“BEMS” means Building Energy Management Systems. “HEMS” means Home Energy Management Systems.

- “Energy Management System” is a product that systematically works together with other equipment and intelligently manages energy usage with sensors and ICT tools.
- For efficient and effective support, the “BEMS Aggregators” provide energy management and operation services to small- and medium-sized buildings.
- In the future, it is expected that the “BEMS Aggregators” will provide Demand Response (DR) services, in which consumers are allowed to adjust electricity consumption taking into account fees for peak hours, point systems, and megawatt trade.



Spread BEMS for small and medium size buildings

Develop energy management servicers - “Aggregators”

<future prospect>  
Develop DR services

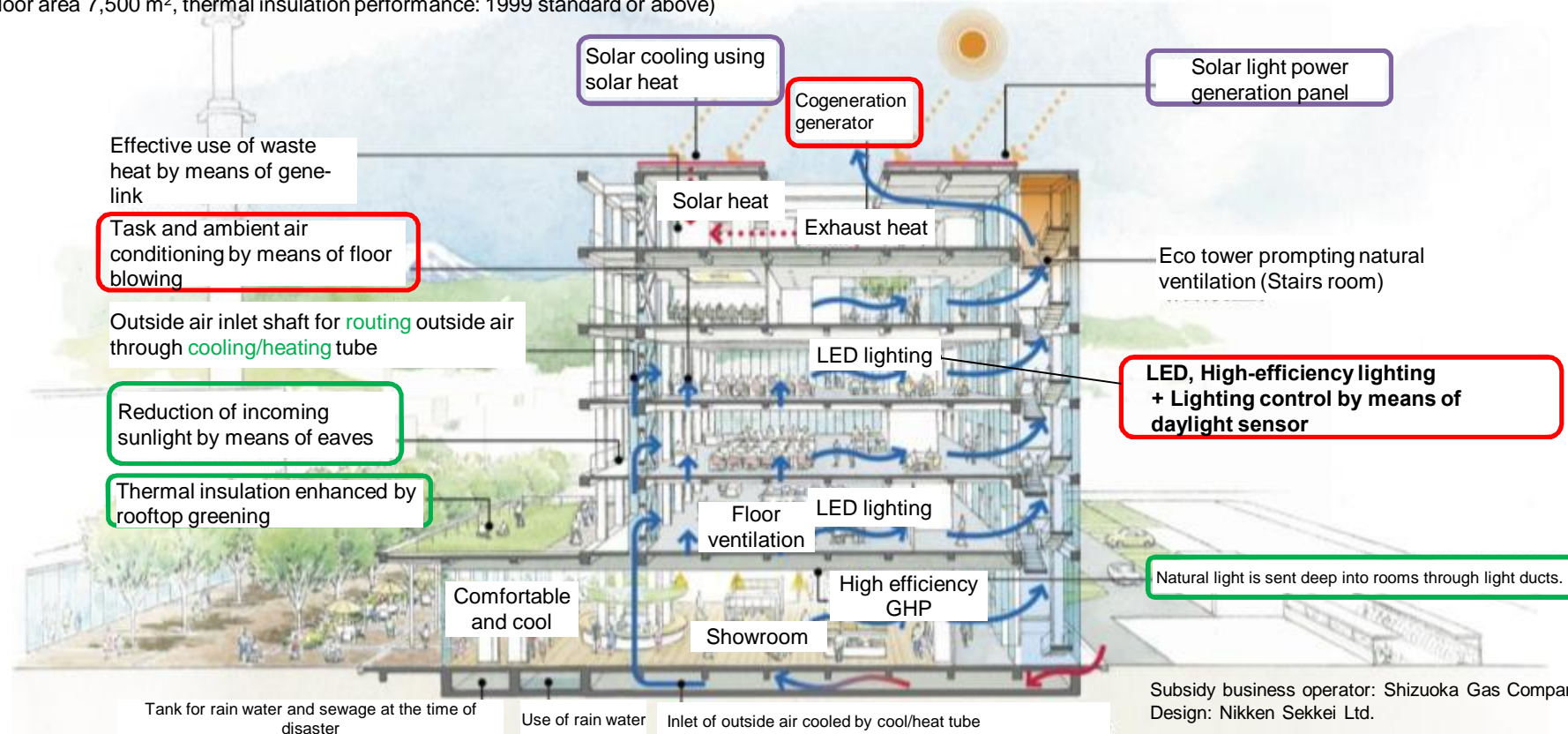


# Actions for Realizing Net Zero Energy Buildings

- To realize net zero energy buildings (ZEB) in 2020, ZEB is pursuing the establishment of a complex system including enhancement of thermal insulation performance, introduction of high-performance equipment, use of renewable energy, introduction of energy management systems, etc.
- The subsidy system to support the introduction of complex systems such as high-performance equipment and to realize ZEB (business promoting net zero energy for houses and buildings) started in FY2012 .

## [Example of subsidy support: Newly built office building]

Name of subsidy business: Shizuoka Gas Company, Head Office Building, net zero energy promotion construction  
(Floor area 7,500 m<sup>2</sup>, thermal insulation performance: 1999 standard or above)



Subsidy business operator: Shizuoka Gas Company  
Design: Nikken Sekkei Ltd.

# Next step in Energy Management

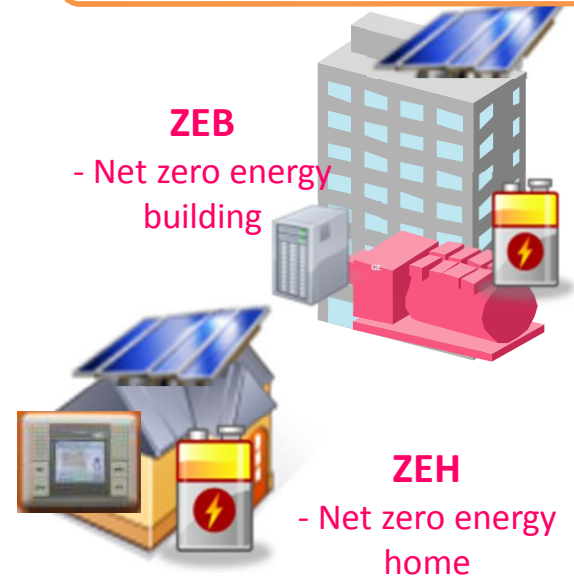
- Handle electricity supply-demand problem with promotion of introduction of HEMS / BEMS, high efficient air conditioners, lighting and hot-water supply.
- Pursue energy efficiency of entire systems by managing entire home and buildings.
- In addition, more efficient energy management can be realized by cross-management of home and buildings, or regional management.

Installation of energy  
management equipment



Cooperate by buying equipment such as efficient air conditioners and lighting, and controlling them with HEMS or BEMS.

Optimize homes and buildings



“Net zero energy” means that net annual primary energy consumption is approximately zero.

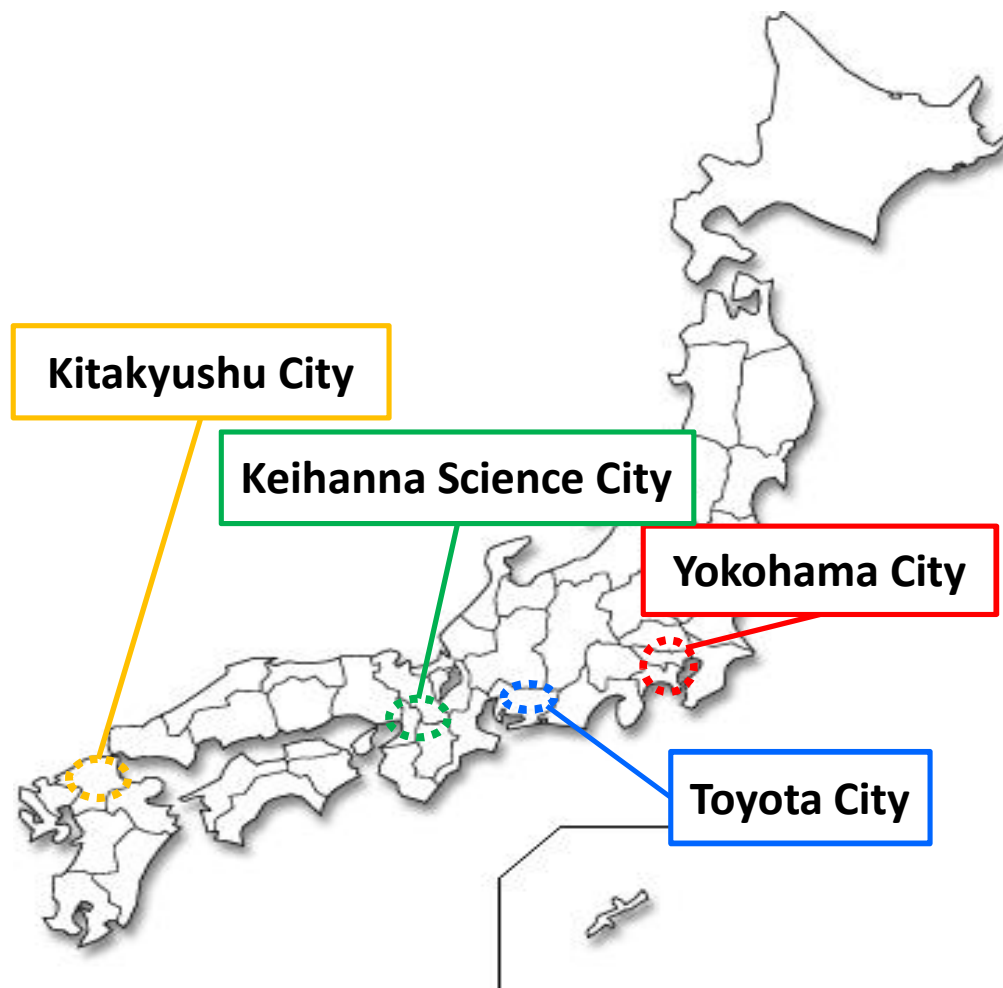
Regional or cross-regional  
optimization





# Demonstration of Smart Communities in Japan

- Starting in FY2011, large-scale smart community demonstration projects have been proceeding in 4 regions across Japan that constitute representative examples of different concepts, with the participation of many residents, local governments, and corporations.



Yokohama City	<u>Wide-area metropolis</u> Introduction of an energy management system for an existing wide-area metropolis. As the sample number is high (4,000 households), demonstration using a variety of strategies is possible.
Toyota City	<u>Separated housing</u> Automatic control of home appliances in 67 homes. Secondary cells equipped in vehicles are used to supply energy to households. Approaches to drivers for reducing a traffic jam
Keihanna Science City	<u>Housing development</u> Demand response demonstration based on a point system is being implemented for general households (approximately 700 households) where PV or HEMS automatic control has not been introduced.
Kitakyushu City	<u>Designated supply area</u> In an area where power is supplied by Nippon Steel Corporation, a pricing system is being implemented where the energy price fluctuates for 2 hours afterwards in accordance with the state of supply and demand of energy for the day, applicable to 50 business establishments and 230 households.

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# Strategic Energy Conserving Technology Innovation Program

Estimated amount from requests for the FY2013 budget - **9 billion yen**

Line of business:

## Summary and purposes of project

- Publicly offered proposal-type research and development, to provide consistent support from the discovery of seeds to commercialization for new and innovative energy conserving technologies, will be carried out in a strategic manner.
- In order to review the current projects for innovative energy conserving technology, developments will be reviewed and further research and development promoted through the collaboration of the industry, academia and government, which are focused on results - targets will be thoroughly enforced through the implementation of the stage gate screenings and support for promising commercializable items will be strongly promoted.
- Consortiums comprised of relevant research and development organizations, as well as users for individual technical domains, are established to set issues for developments pertaining to specific technologies and formulate energy conserving technology strategies, in order to promote technological innovations, efficient technology developments and secure effectiveness of business operations.

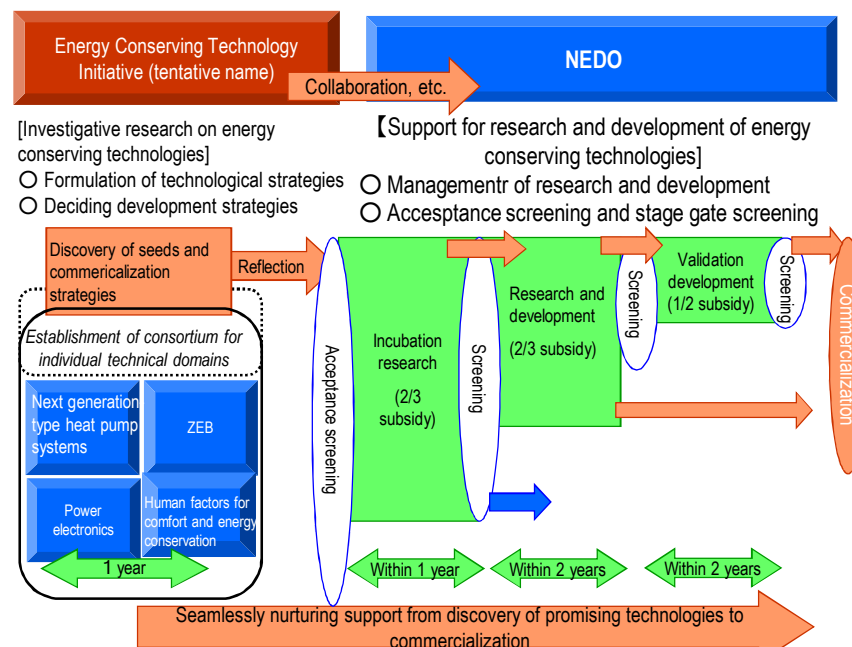
## Conditions

(eligible entities, eligible activities, subsidy rates, etc.)



Image of business operations

Image of project for "Strategic Energy Conserving Technology Innovation Program"



	Incubation research	Research and development	Validation development
<b>Summary</b>	Advance research and formulation of development and implementation scenarios in order to assess development investments for promising energy conserving technologies.	Research and development for practical implementation are conducted. Target attainment is thoroughly implemented through appropriate management of research and development through advice provided by external experts, etc.	Further technological developments and verification is conducted in order to overcome inhibiting factors for technologies that have undergone practical implementation, but for which attracting business opportunities is difficult.
<b>Eligible entities</b>	Enterprises, universities and research institutions	Enterprises, universities and research institutions	Enterprises, etc.
<b>Upper limit amount</b>	Approx. 20 million yen per case	Approx. 300 million yen per case	Approx. 1 billion yen per case
<b>Subsidy rate</b>	2/3※	2/3※	1/2
<b>Implementation period</b>	Within 1 year	Within 2 years	Within 2 years

\* For industry, academia and government collaborations only; 100% subsidy for public research institutions.

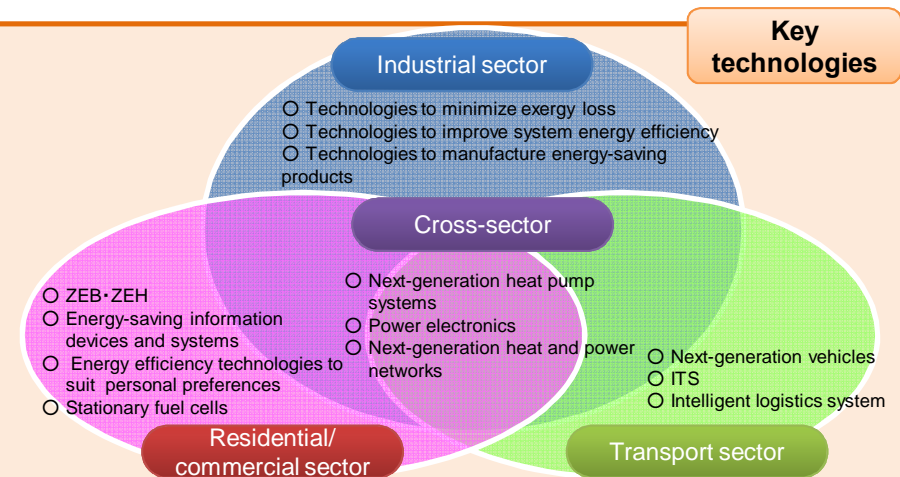
# Outline of 2011 Strategy for Energy Efficiency Technologies

## Objectives

- In order to achieve established goals included in the Basic Energy Plan by 2030, the 2011 Strategy for Energy Efficiency Technologies aims to develop energy efficiency technologies, promote the introduction and international deployment of such technologies, serve as a guideline for stimulating economic growth and realize Japan's aspiration to be the world's leading nation in terms of energy efficiency technologies.
- This strategy therefore prioritizes wide-ranging energy efficiency technologies and selects key technologies that can meaningfully contribute to Japan's energy-saving efforts.
- At present, the strategy is undertaking amendment for next version.

## Overview

- (1) Select key technologies for each sector and develop a roadmap  
Selection criteria:
  - ① Technologies that are expected to achieve significant energy-saving effects by 2030
  - ② Systems that can be combined with other technologies or integrated in new concepts to achieve significant energy-saving effects
  - ③ Technologies that are expected to achieve significant energy-saving effects and are broadly applicable on a long-term basis
- (2) Enhance convenience by adopting a Technology Strategy Map (energy-saving areas)+
- (3) Propose innovative energy-saving methods using new concepts such as systemization to achieve overall optimization



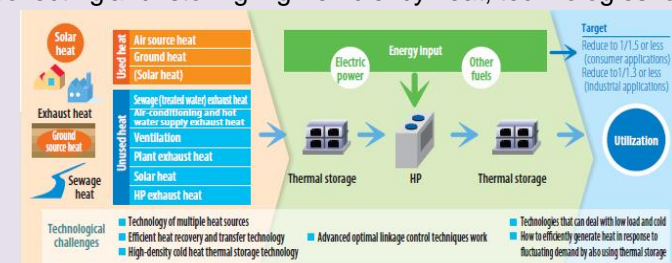
## Next-generation Heat Pump Systems

System to achieve high-efficiency, low cost heat pumps and reduce greenhouse gas emissions by developing systemization and innovative element technologies for heat pumps.

- **Systemization technologies:** Technologies for utilizing unused heat, technologies for collecting and storing high-efficiency heat, technologies for streamlining low load areas, etc.
- **Innovative element technologies:** Technologies for high-efficiency refrigeration cycles, development of new refrigerants, high-efficiency heat exchange equipment, technology for high-efficiency compressors, etc.

Examples:

- HPs for home, office buildings and factory air-conditioning
- HPs for car air-conditioning
- Industrial use HPs
- HPs for hot water
- HPs for refrigerators, freezers, etc.



# R&D project on next heat pump sytem

Estimated requested amount for the FY2013 budget - 0.14 billion yen

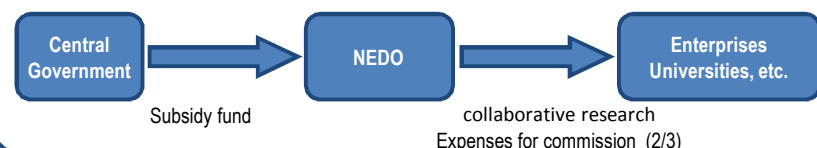
## Line of business

### Summary and purposes of project

- In order to achieve increasing energy efficiency of heat pumps, it is necessary to improve overall system developments in addition to individual elemental development.
- This project encourages the development of next generation heat pumps which integrate technologies to improve every facet of the heat pump, and we aim to introduce expand applications and advanced use of energy.
- In fy2013(the last year), we are going to get safety data from long term system operation ever constructed, and evaluate its system performance.

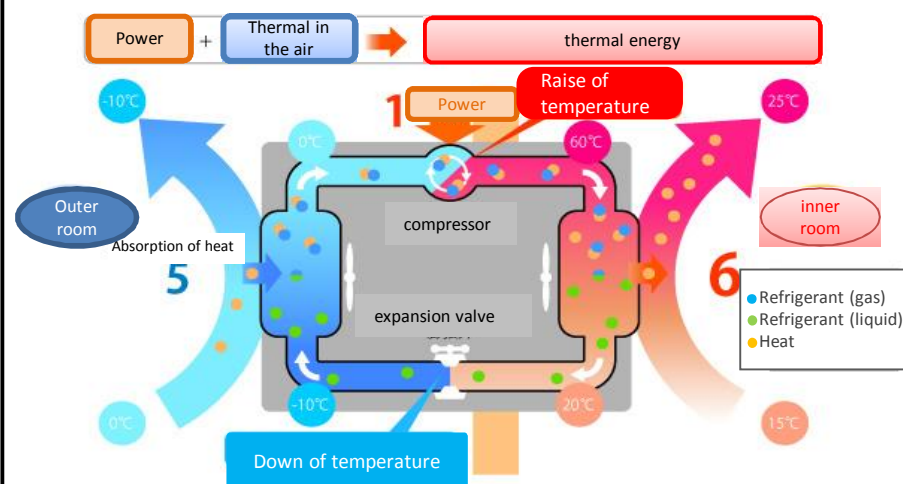
### Conditions

(eligible entities, eligible activities, subsidy rates, etc.)



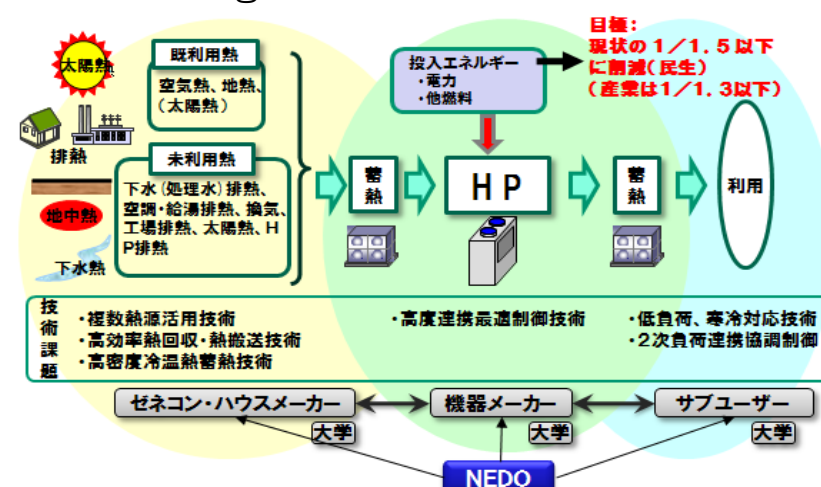
## Image of business operations

### < heat pump principle >



Source: Heat Pump & Thermal Storage Technology Center of Japan

### <R&D Image>



**Thank you!!**