Energy Efficiency - How Japan did it?

Energy Conservation Technology Department

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Director

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What's NEDO ?

As Japan's largest public management organization promoting research and development as well as the dissemination of energy, environmental and industrial technologies, NEDO has a crucial mission to carry out.

- **Addressing energy and global environmental problems**
- **Enhancement of Japan's industrial competitiveness**

Chairman:	Mr. Kazuo Furukawa
Organization:	-Incorporated administrative agency under the Ministry of Economy, Trade and Industry (METI), government of Japan - Established in 1980
Location:	Kawasaki City, Japan
Personnel	About 800
Budget	Approximately 148.4 Billion yen (2014 fiscal year) (1.5 Billion US dollars)

NEDO's Technology Area

Basic Research → **Technology Development** → **Demonstration**

Renewable energy

Energy conservation

Electronics /ICT

Materials/nanotech

Energy storage

Water treatment

Smart community

Environment/ clean coal

Robotics

Bio/medical

Energy Efficiency Technology R&D Results

○ World's First Hybrid Hydraulic Excavator

– Achieving considerable energy savings and less CO_2 emissions –

Participants: Kobelco Construction Machinery, Kobe Steel, Ltd.

FY1999–FY2004: NEDO R&D of Hybrid Excavator

FY2006: Completion of hybrid excavator development

FY2009: Start of sales

○ High-performance Furnace "Regene Burner"

– Drastic decrease in process energy and environmental burden –

Participants: Japan Industrial Furnace Manufacturers Association, others

FY1993–FY2000: NEDO R&D of High-performance Industrial Furnace

- Succeeded in achieving more than 30% energy saving and lower CO_2 emissions as well as more than a 50% reduction in NOx emissions
- More than 1,300 furnaces are being used in Japanese factories

Energy Conservation R&D Results

○ Contributing to Expanding the Market for EcoCute

– Drastic decrease in size and adaption to narrow space –

Participant: DENSO Corporation

FY2005–FY2007: NEDO R&D of Compact Heat Pump System

- Space saving EcoCute integrating a hot water storage tank into a single body has been put on the market.

○ "Clean Diesel": World's Highest Level of Fuel Consumption and Exhaust Cleanness Launched

Participant: MAZDA

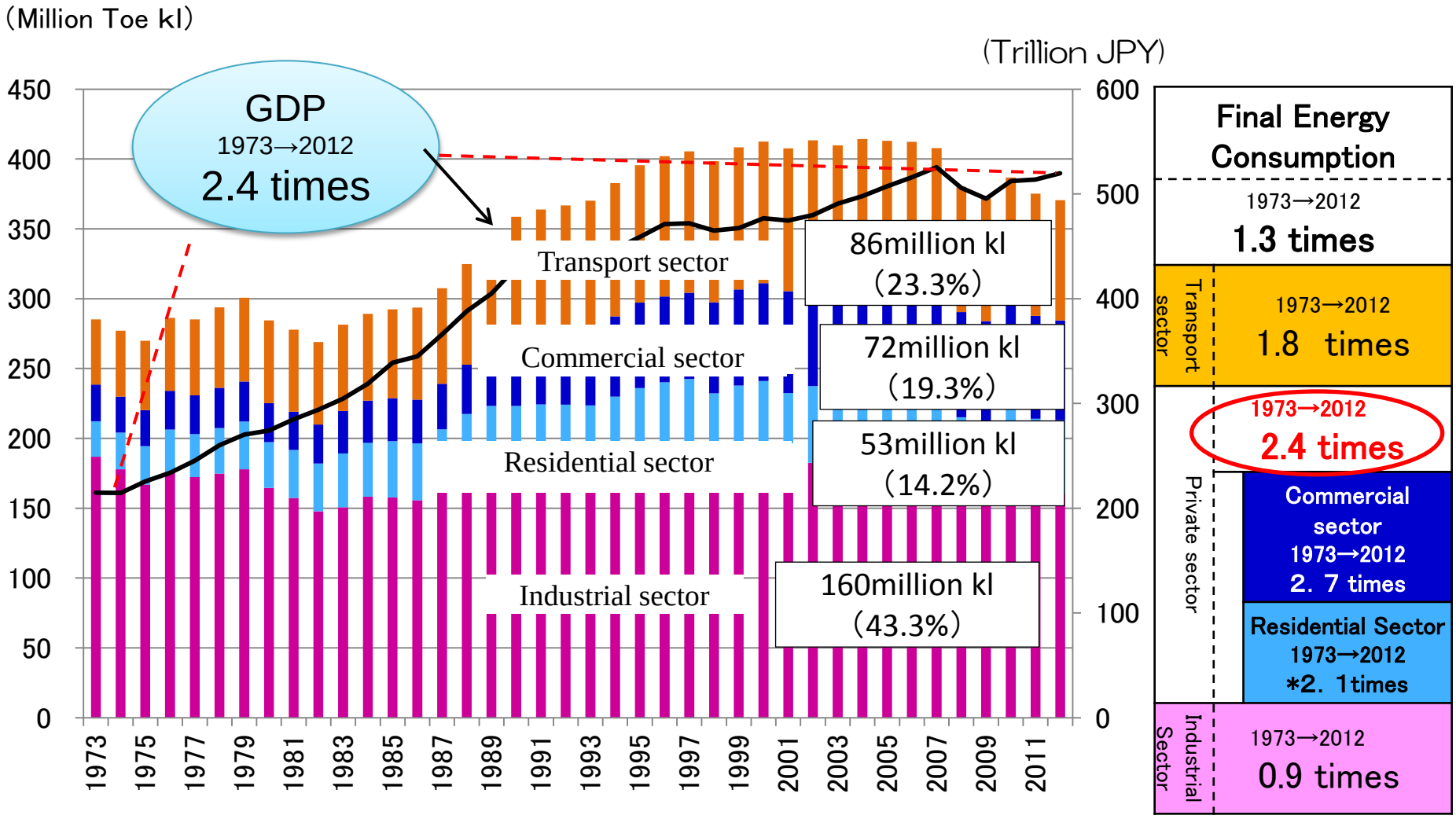
FY2004–FY2008: NEDO R&D of Innovative Next-generation Low Emission Vehicle

FY2012: Achieved world's highest level of fuel efficiency and lowest NOx exhaust level; "SKYACTIV-D" put on market.

October 2014: Received Japan Car of the Year Award

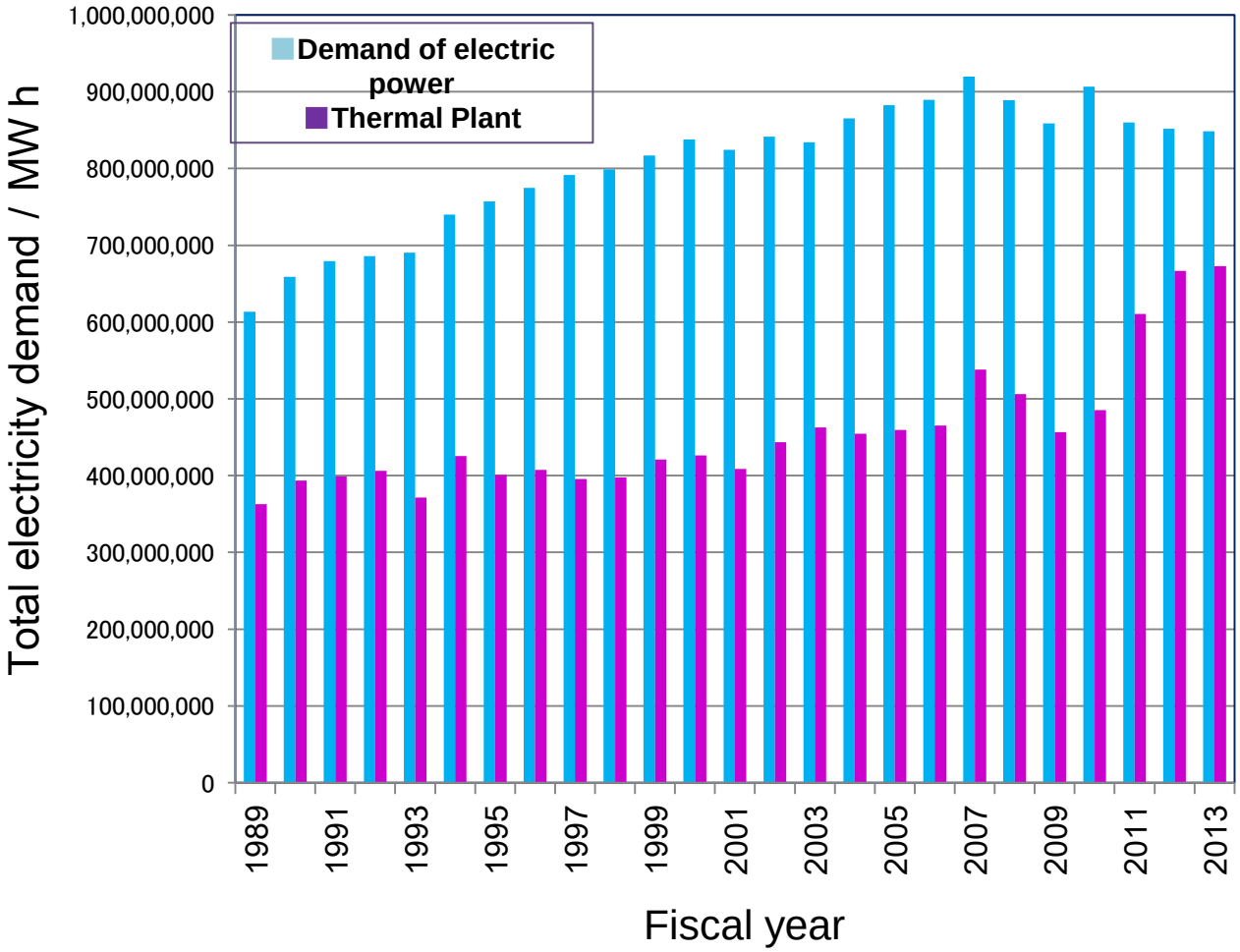
Status of Japan's Energy Consumption

◆ Japan's GDP has increased 2.4 times since the 1973 oil crisis, while industrial sector energy consumption has increased 10%. The industrial sector accounts for 40% of total energy consumption. The energy consumption of the commercial sector has also increased 2.4 times.



Status of Japan's Energy Consumption

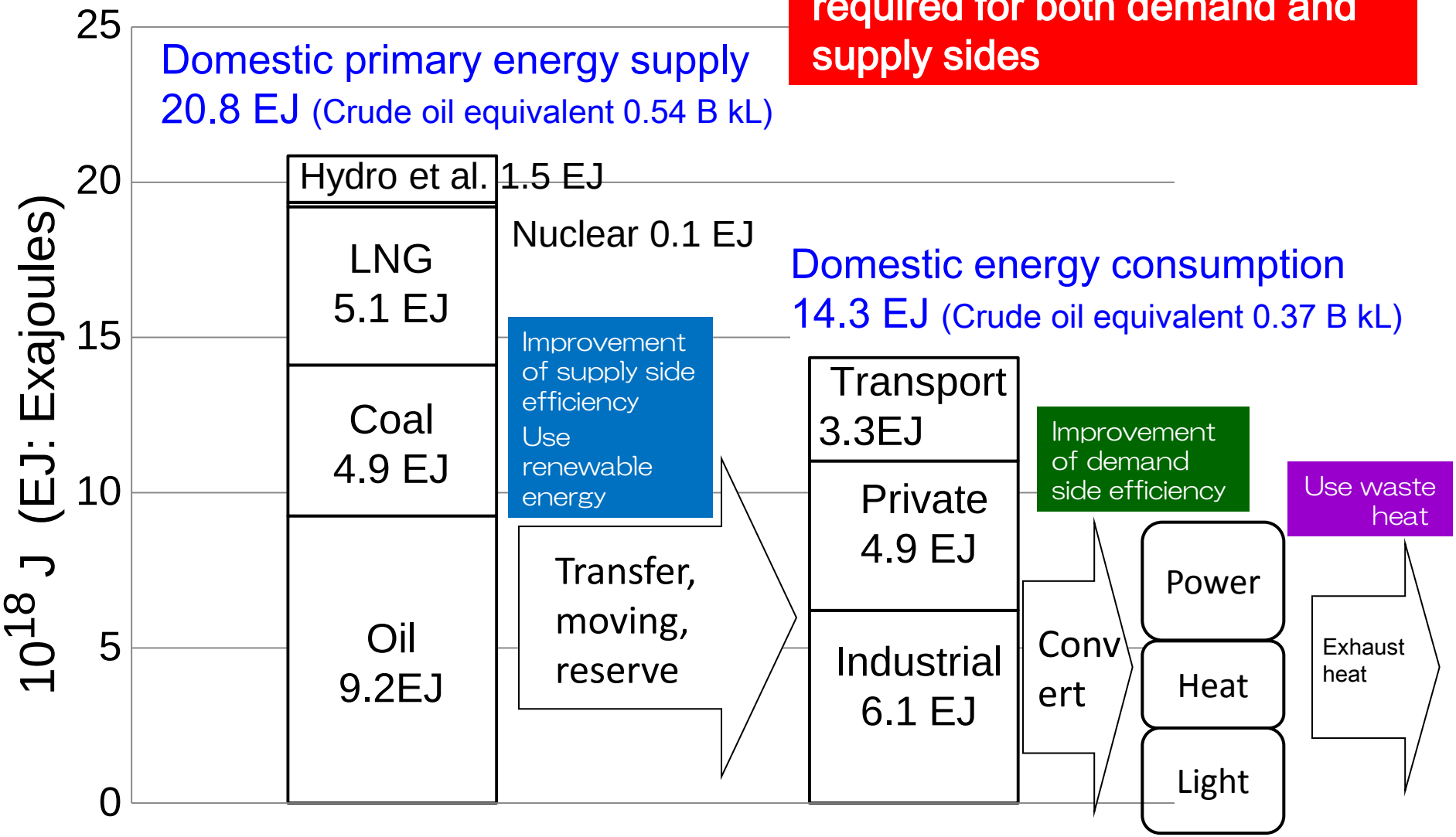
Demand for electricity and contribution of thermal power plants (FY1989–FY2013)



- In the 1990s, demand gradually increased.
- After the tsunami disaster, energy conservations efforts **reduced electricity demand by 5%**.
- The share of thermal power generation has **reached 80%** of the total electricity supply.

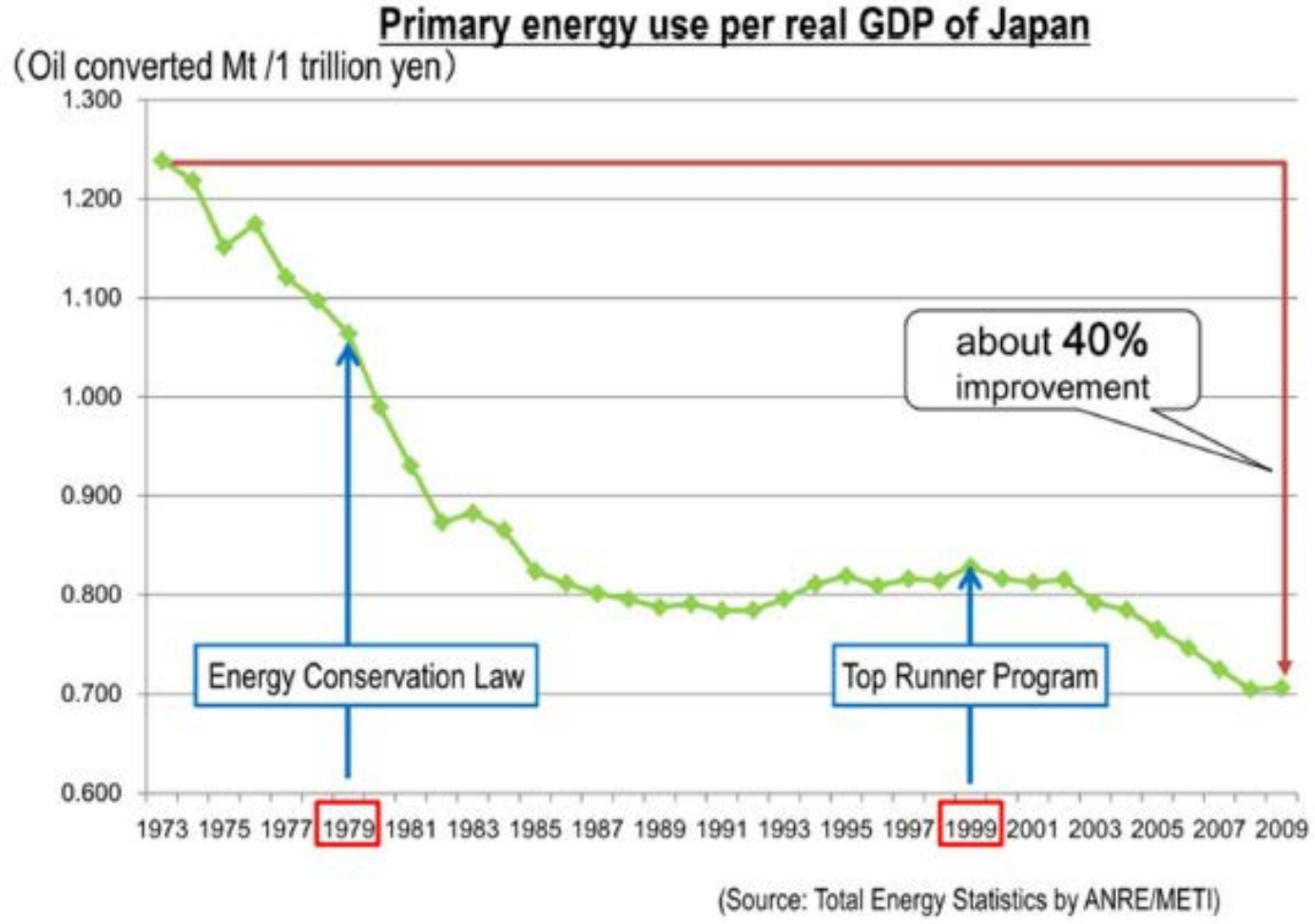
Energy Losses in Japan

Countermeasures are strongly required for both demand and supply sides



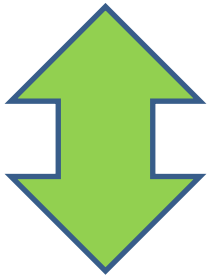
Improvement of Japan's Energy Efficiency

◆ Japan has improved its energy efficiency by about 40% since 1970s through continued efforts for energy conservation. The Energy Conservation Law was introduced in 1979, and The Top Runner Program started in 1999.



Basic Strategy to Improve the Energy Efficiency

Deployment of energy conservation technologies with "The Top Runner Program"



Combination of both way is Important to improve energy efficiency

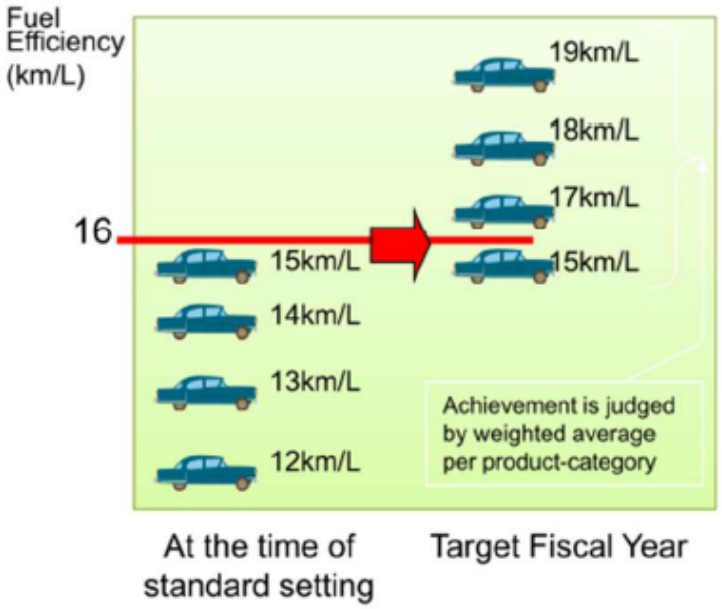
Development of energy conservation technologies with "Strategic R&D"

Basic Strategy to Improve the Energy Efficiency

"The Top Runner Program"

- "The Top Runner Program" is a mandatory program that encourages competition among companies by setting efficiency targets 3 to 10 years in advance.
- Companies make efforts toward these goals; the program has contributed to improvement of energy efficiency of consumer electronics and automobiles in Japan.

Example of Top Runner Program



Improvement of energy efficiency

Gasoline-passenger vehicles
48.8% (FY1995→FY2010)

Air-conditioners
(For those of 4.0kW or less in cooling capacity)
16.3% (FY2005→FY2010)

Refrigerators
43.0% (FY2005→FY2010)

TV sets (LCD and PDP TV)
29.6% (FY2004→FY2008)

etc.

source: Ministry of Economy, Trade and Industry (METI)

Basic Strategy to Improve the Energy Efficiency

"The Top Runner Program"

Specified equipment (28 items, as of January 2014)

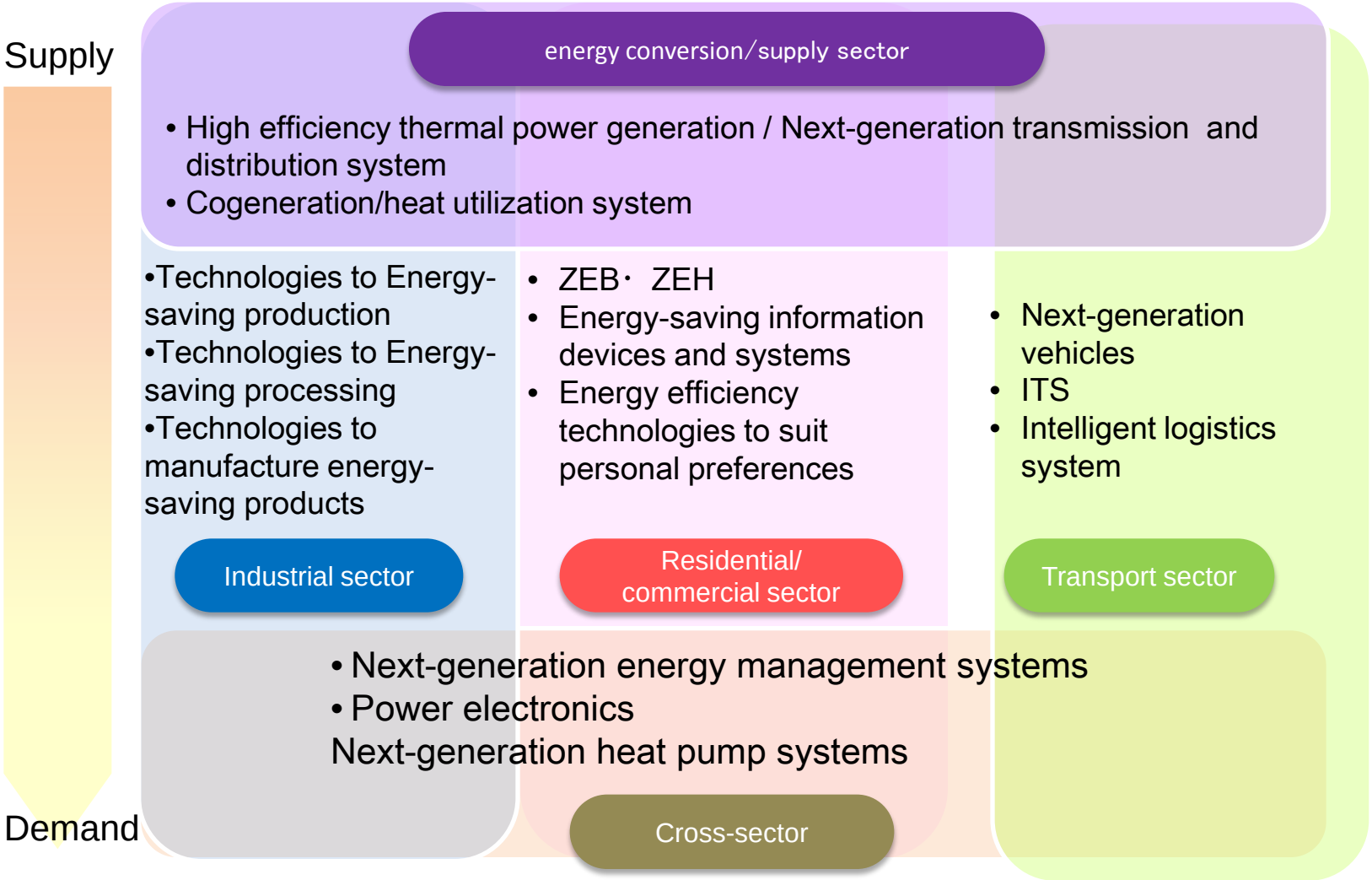
1. Passenger cars
2. Trucks
3. Air conditioners
4. Television receivers
5. Video tape recorders
6. Lighting apparatuses
7. Copying machines
8. Computers
9. Magnetic disk devices
10. Electrical refrigerators
11. Electrical freezers
12. Heaters
13. Gas cooking appliances
14. Gas water heating appliances
15. Oil water heaters
16. Electric toilet seats
17. Vending machines
18. Power transformers
19. Jar rice cookers
20. Microwave ovens
21. DVD recorders
22. Routing equipment
23. Switching equipment
24. Multifunction office machines
25. Printers
26. Heat pump water heaters
27. Industrial motors (three-phase induction motors)
28. LED lamps

3-phase induction motors

LED lighting

“The Strategic R&D”

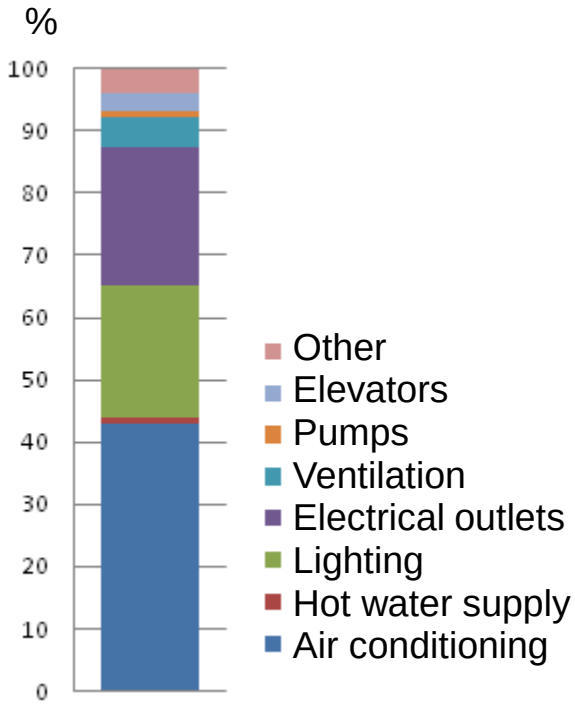
Key Technologies for Energy Efficiency



Example : Energy Consumption Improvement in Buildings

Energy consumption is around 1500 MJ/m^2 after the 3/11 earthquake disaster. However, further reductions are necessary. Air conditioning, lighting, and electrical outlets consume most of the energy used in Japan's buildings.

Breakdown of energy consumption



From ZEB demonstration,

- 900 MJ/m^2 of energy conservation is possible by introducing the latest technologies through demonstration projects.
- ZEBs of up to two-stories are foreseeable assuming further technological development of both renewable energy and energy conservation in the future.
- Following problems are identified for general construction.
  - Technology related to skin performance improvement has not been adopted for economic reasons.
  - Internal load reduction does not naturally take place.
  - Excessive device functionality leads to reduced energy efficiency due to it becoming part of the operational load.

Example : Plans for Realizing ZEB in Office Buildings

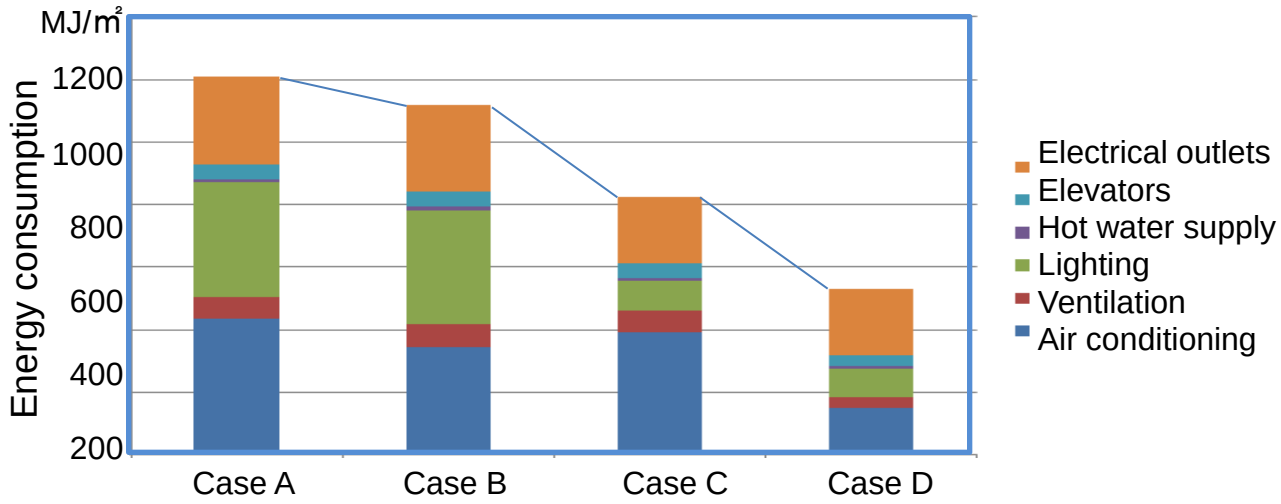
- The Japanese government set the goals described below in its Basic Energy Plan (revised edition 2014).

Targets for creating net zero energy buildings (ZEB) in approximately half of the new public buildings from 2020, and in all new buildings from 2030.

- A drastic cut of 50% energy use from current levels is needed. Industry, academia and government cooperation is necessary to achieve this challenging goal.

Implementation as a NEDO Project is Necessary for Success.

Example : Plans for Realizing ZEB in Office Buildings



Priority should be given to the introduction of building materials which are difficult to add during renovations. Optimal equipment should then be selected according to the amount of heat load that is reduced through the use of building materials.

Direction of Technology Development

Concept of architectural design

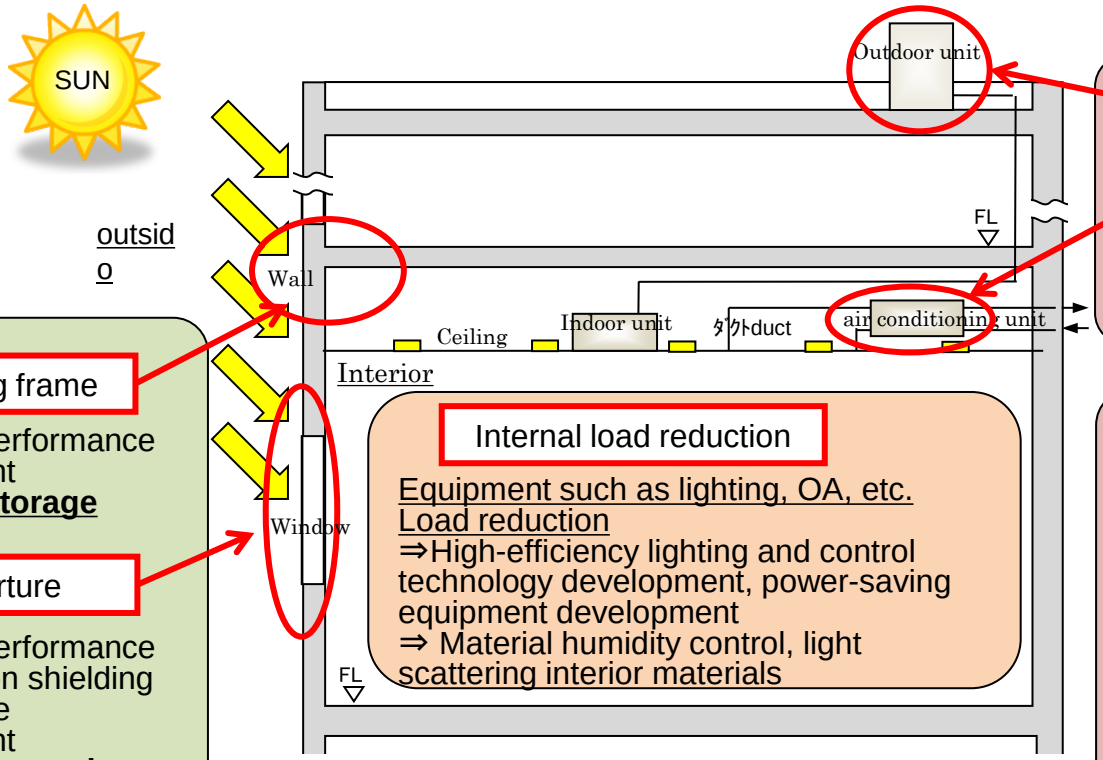
①Passive design

②Internal load reduction

Optimal load

Optimal Equipment

③Optimal design of the equipment



Air-conditioning system

Efficiency improvement

Ventilation

Latent heat processing

⇒Desiccant equipment

Building frame

Insulation performance improvement

Thermal storage

Aperture

Insulation performance And radiation shielding performance improvement

Use daylight and solar radiation heat

Internal load reduction

Equipment such as lighting, OA, etc. Load reduction

⇒High-efficiency lighting and control technology development, power-saving equipment development

⇒ Material humidity control, light scattering interior materials

Building energy management system

Integrated control

Human factors

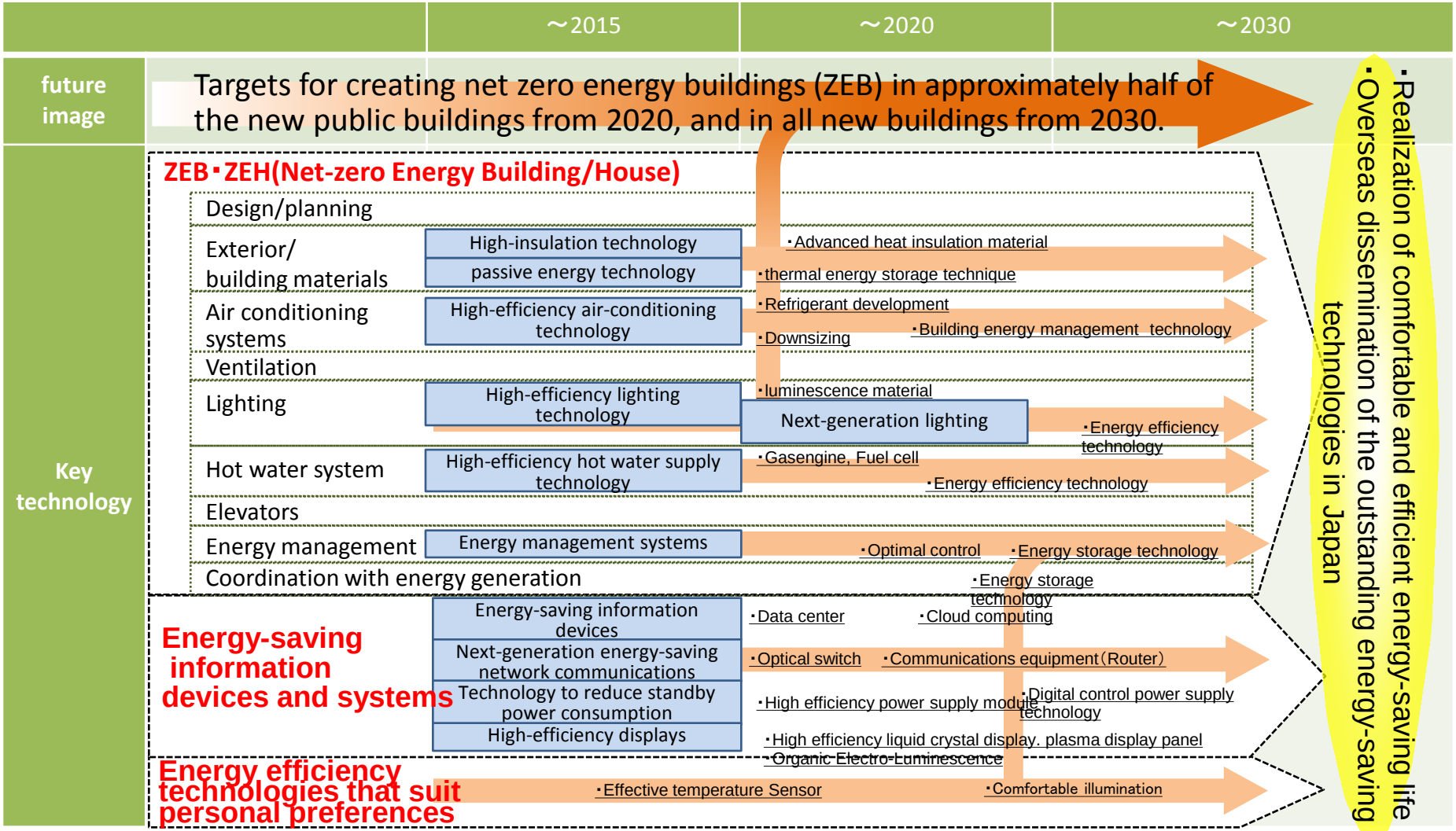
⇒Architecture and air-conditioning integrated control system

Sensor

Environmental grasp

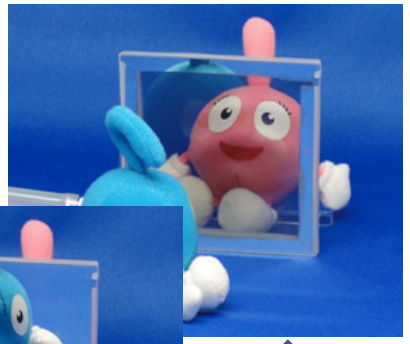
Direction of technology development

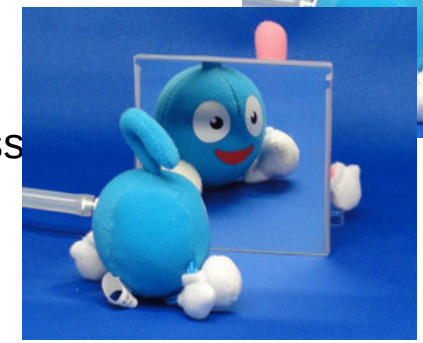
The Strategic R&D with Roadmap

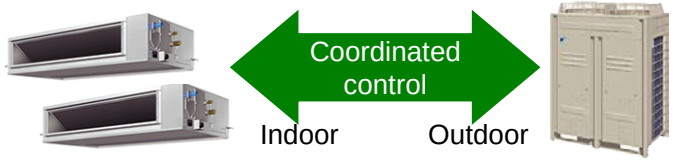


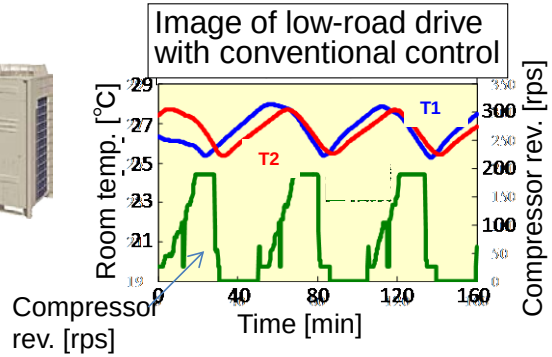
Technologies Contributing to Realization of ZEB

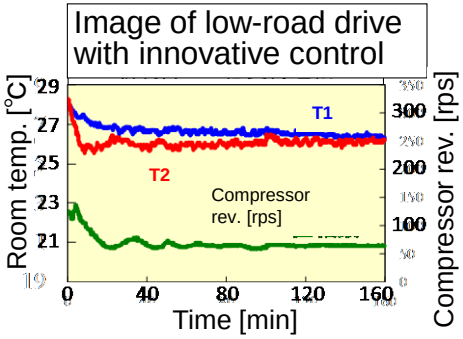
- Performance improvements and upgrades in the capabilities of building materials
  - Insulation improvement of building materials having variable thermal barrier performance
- Internal load reductions
  - Lighting control technology（Intelligent lighting・"brightness feeling" lighting ）
  - Individual air-conditioning technology（Liquid-cooled air conditioning・ wearable devices）
- Air-conditioning equipment performance improvements
  - Development of latent heat processing technology （desiccant equipment）
  - Development of next-generation heat-pump systems （Improvements in low load efficiency・ Unused heat utilization）









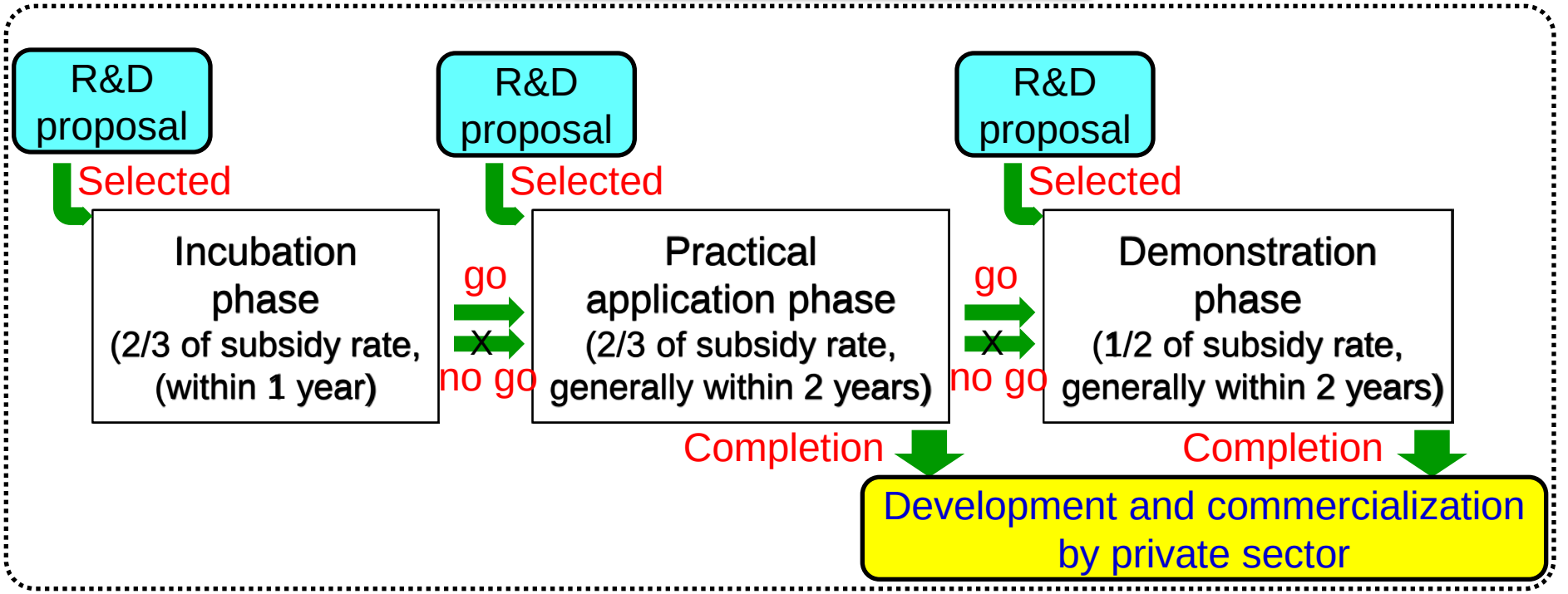


“The Strategic R&D”

Strategic Innovation Program for Energy Conservation Technologies

FY2012–FY2021: Annual budget：9.3 billion yen (in FY2014)
R&D on more than 50 themes is now being carried out.

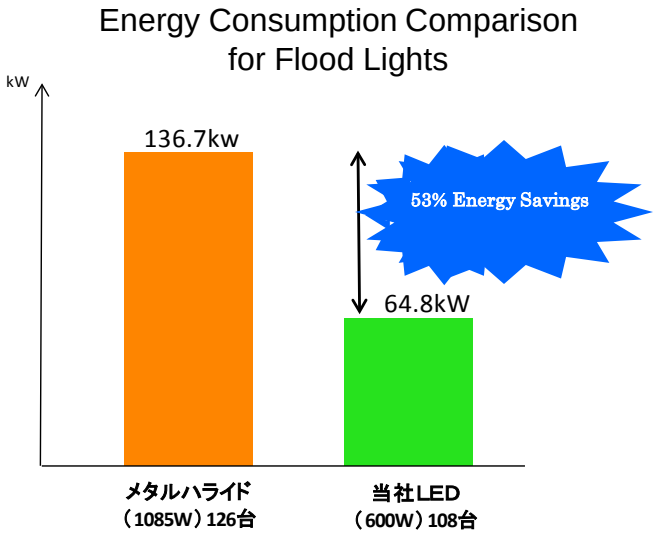
Scheme of R&D Projects



Recent Activities(News Release）

NEDO Project Leads to a High-Efficiency LED Lamp with Ultra High Intensity and Ultra High Flux （ 6,000lux ）

LED lamp
(Flood light model)

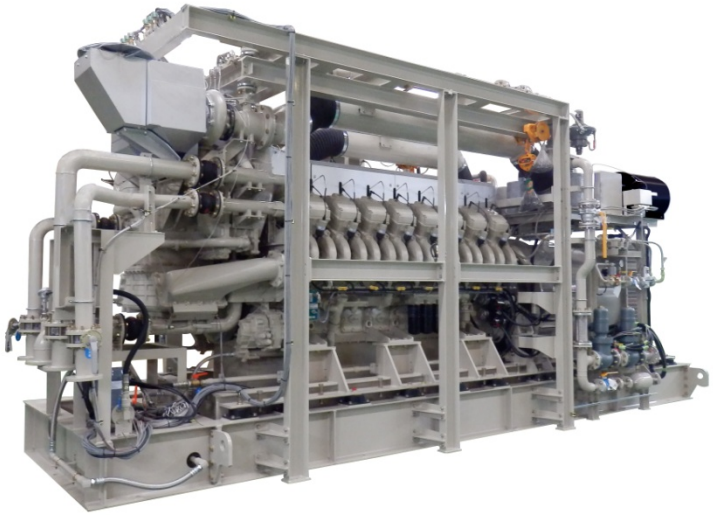


Shikoku Instrumentation Co
(2014.10.7 News release)

⇒This project develops high-performance heat radiation system and high density lightening structure through academic-industrial-collaboration. It realizes a miniaturization with ultra high intensity and ultra high flux. “It enable us to read book in 300m away”

Recent Activities(News Release）

NEDO Project leads to a New high-efficiency (44.7%)
2MW Gas Generator



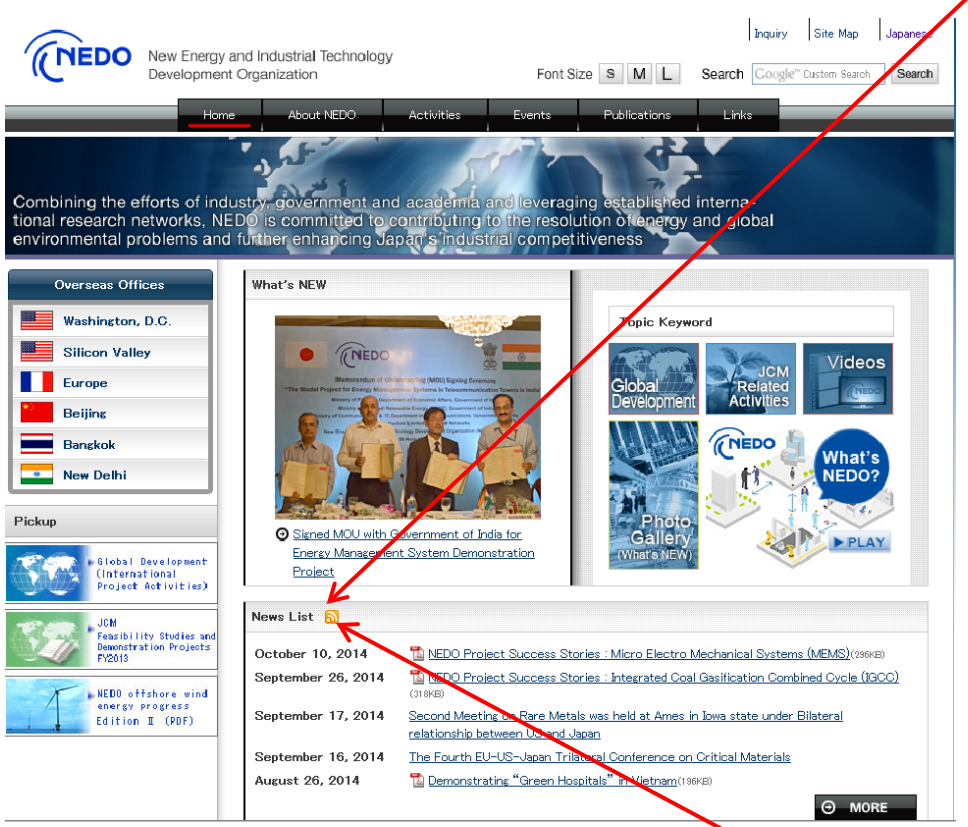
Mitsubishi Heavy Industries, Ltd.

(2014.8.6 news release)

⇒Improving energy efficiency is urgent because energy cost and demand for electricity has been increasing after the Great East Japan Earthquake. Demonstration of high-efficiency 2 MW Gas Generator being applied to multi-purposes will begin.

How to Get the Latest Information on NEDO's R&D

Visit our Web site: http://www.nedo.go.jp/english/index.html



News Release

NEDO
New Energy and Industrial Technology Development Organization
http://www.nedo.go.jp/english/index.html

August 6, 2014

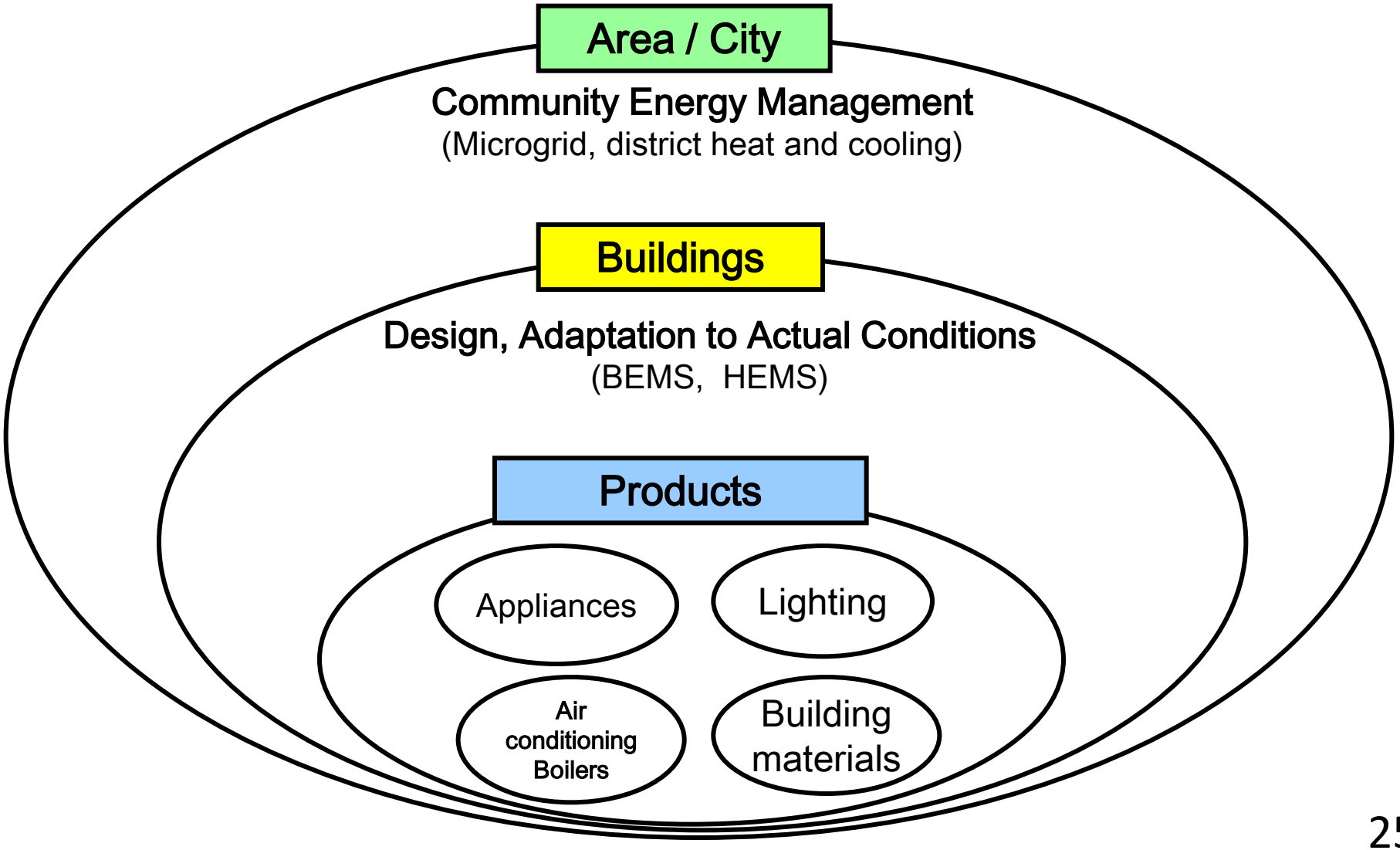
NEDO Project Leads to a New High-efficiency 2 MW Gas Generator — Demonstration Testing Begins in September to Confirm the World's Highest Level of Power Generation Efficiency —

As part of a project under the auspices of the New Energy and Industrial Technology Development Organization (NEDO), Mitsubishi Heavy Industries, Ltd. has developed a 2 MW 16 cylinder high-speed gas engine power generator that achieves one of the world's highest ratings for power generation efficiency.[1] By employing technologies, such as two-stage turbocharging[2] and the Miller cycle,[3] this new gas engine's power generation efficiency exceeds a lower heating value (LHV)[4] of 44.7%, which is one of the highest ratings for high-speed gas engine power generators used in combined heat and power cogeneration systems and applications.

Starting in September, demonstration testing using a prototype of this new gas engine will be conducted with the goal of verifying practical application for decentralized power generation, emergency and backup power generation, microgeneration, and cogeneration.

Exterior view of 2 MW 16 cylinder gas engine high-speed power generator prototype

Change the border of energy management
⇒ Focus on systematization



Thank you for your attention.

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