Seminar for Industry and Building EMS

Policy and Technology for Energy Efficiency in Japan

April 26, 2016

JICA Project Team

(TEPCO HD)

1. Introduction of JICA's Project

Outline

1. Donor

Japan International Cooperation Agency (JICA)

2. Consultant

TEPCO HD & YSK Consultants JV

3. Project Period

2014/3-2017/4

4. Purpose of the Project

Assistance for preparation and implementation of EMS

5. Components (JICA's Assistance Portion)

Component 1: Preparation of the scheme and dissemination

- Based on the EE&C Law issued in March 2013, the secondary legislation (detailed regulations, format, qualification system) are prepared and dissemination programs are implemented.

Component 2: Preparation and implementation of training programs

- Creation of training program for Energy Auditor (EA), training of trainers for EA, and assistance for training with exam. for EA conducted by Training Organization (TO)
- Creation of a training program using training facilities, training of trainers for training facilities for Energy Manager (EM) and assistance for training for EM conducted by TO

Component 3: Follow up after implementation of EMS

- Assistance for operation of EMS and follow up

Overview of Japan

Hokuriku

New “Shin-kansen”
(Debut: March 14, 2015)

Hokkaido

Kyoto

Tokyo

TEPCO Service Area

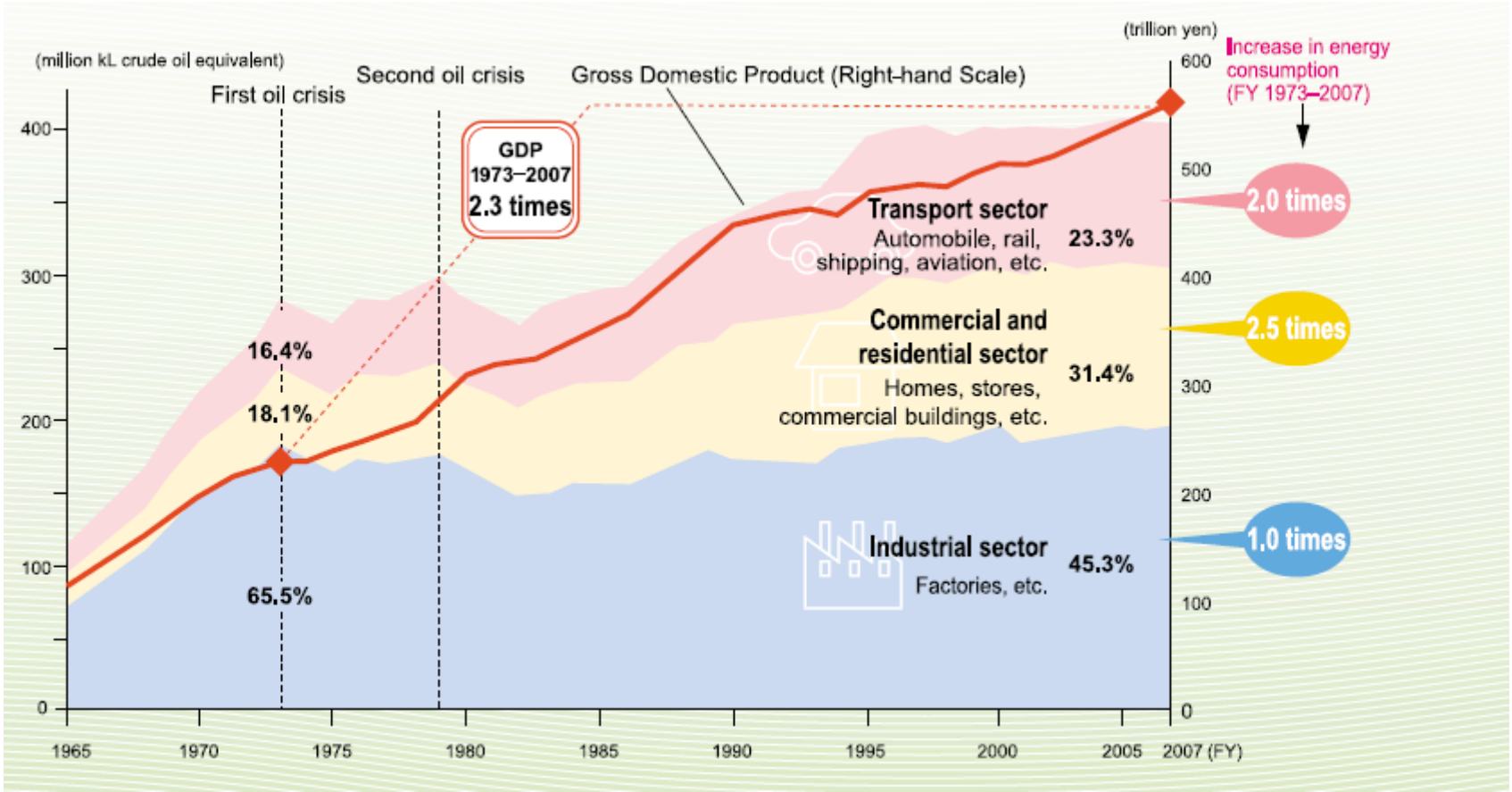
Mt. Fuji

Okinawa

TEPCO (FY2013)	
Peak demand	64.3GW (July 2001) 50.9GW (Aug 2013)
Service area	39,542km^2
Demand density	1288kw/km^2
Population in service area	45 million
UG transmission line circuit length	12,073km
OH transmission line circuit length	28,247km

2. Policy for Energy Efficiency in Japan

Historical Data of Final Energy Consumption by Sector

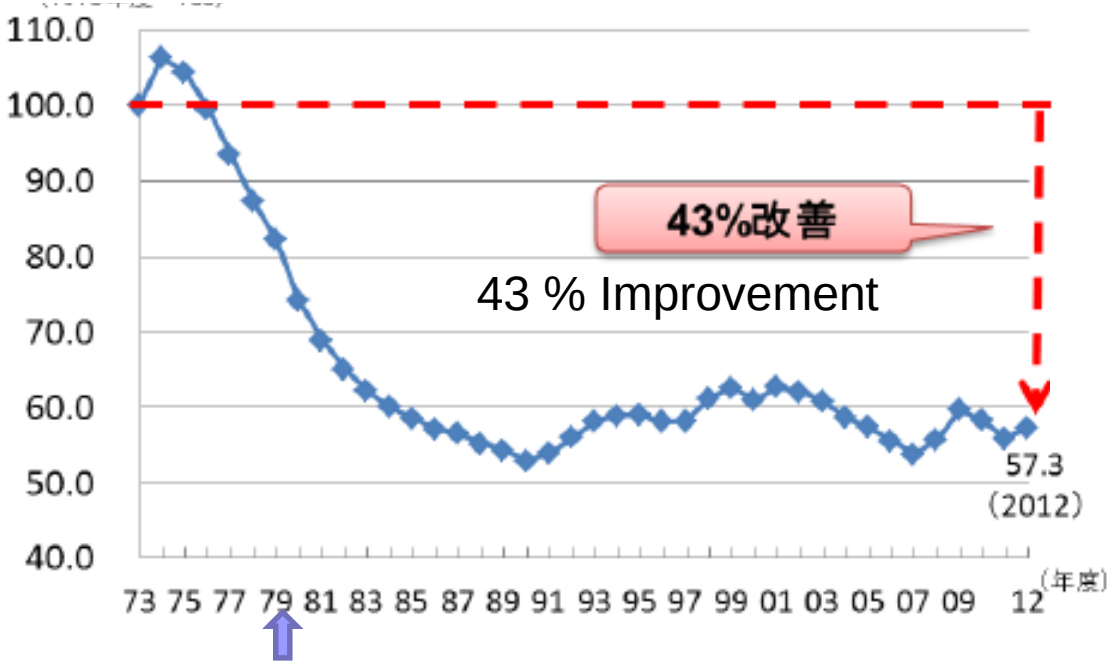


- GDP has grown 2.3 times since 1973. However, energy consumption of industrial sector has been flat due to promotion of energy efficiency.

Energy Intensity of Manufacturing Sector

- Energy intensity of manufacturing sector in Japan has been improved since 1973.
- However, from 1990's, energy intensity has not been improved so much. Further improvement efforts are needed.

Energy Intensity = Energy consumption / production unit
(Value of 1973 is 100)



Law on Rational Use of Energy
(Energy Conservation Law) was enforced in 1979.

(Source: METI)

Law on Rational Use of Energy (Energy Conservation Law) in Japan

Targeted Energy under the Energy Conservation Law

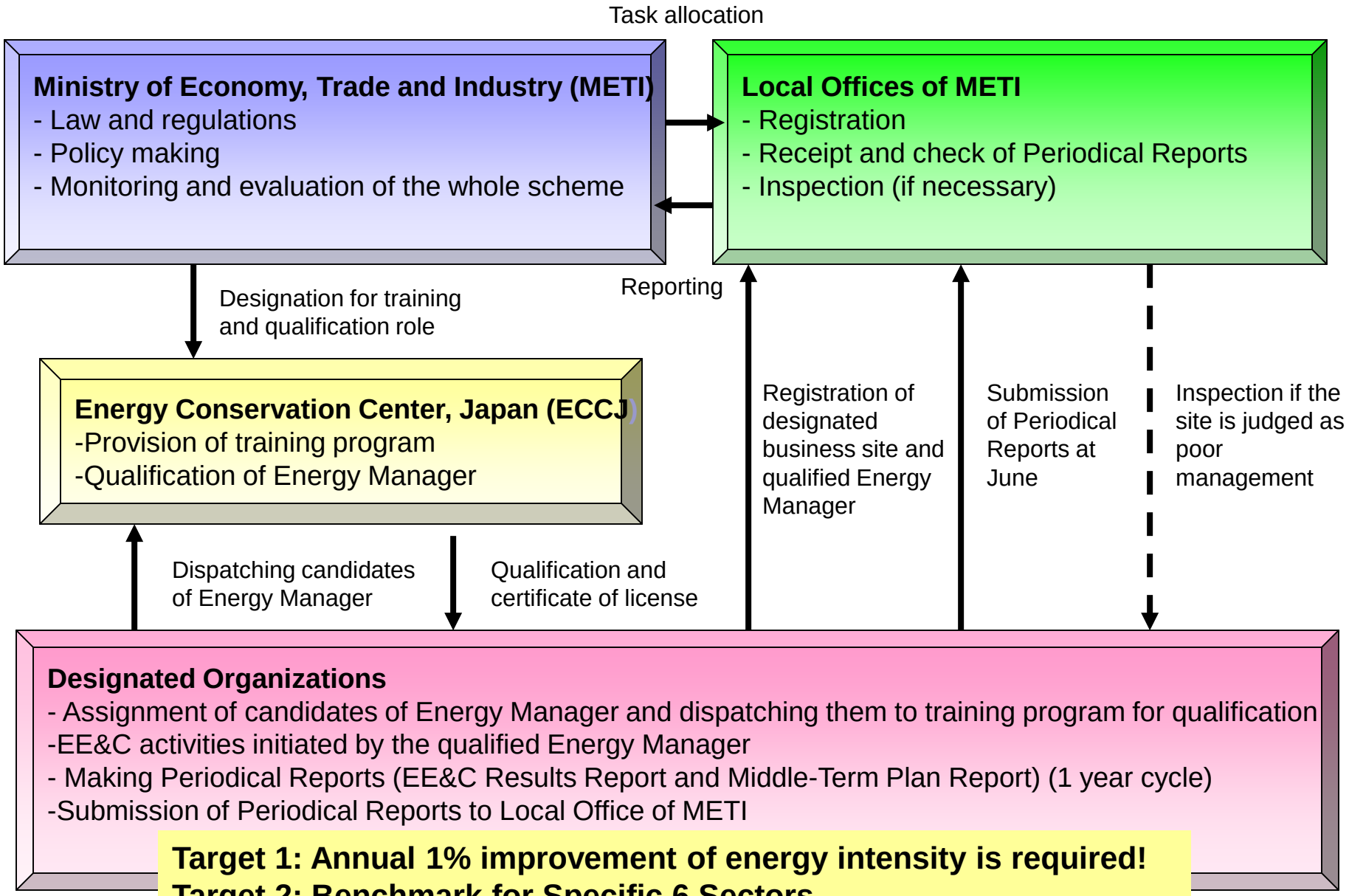
The term "Energy" as defined in the Energy Conservation Law refers to "Fuel", "Heat" and "Electricity".
Namely, target of this law is reduction of "fossil fuels"

Fuel	■Crude oil, volatile oil (gasoline), heavy oil and other oil products ■Combustible natural gas, ■Coal, coke and other coal products
Heat	■Heat generated from Fuel (Steam, Hot Water, Cold Water, etc.) (Excluded: heat generated that is NOT "Fuel-based", such as solar heat, geothermal heat etc.)
Electricity	■Electricity generated by fossil fuels (Excluded: NON-fossil-fuel such as photovoltaic generation, wind power generation, waste power generation, etc)

Measures for Energy Conservation in Japan

		Industrial Sector	Commercial and Service Sector	Residential Sector	Transportation Sector
Regulation	Energy Conservation Law	**Energy Management System (EMS)**			Regulations for transportation
		Report on Energy Saving Measures for New Construction, Renovation of Large Building			
		Labeling Scheme The Top-Runner Program			
		Information, Education and Communication			
Incentive	Subsidy	Grants for purchasing energy-efficient (EE) equipment and cars			
	Tax reduction, low interest public loan	Special depreciation or tax mitigation for EE equipment			
		Public loan for small & medium companies purchasing EE equipment		Tax reduction for EE houses	
	Others	Awarding scheme, Offering energy efficiency diagnoses tools, Offering information, etc.			

EMS in Japan


Task allocation
Ministry of Economy, Trade and Industry (METI)
- Law and regulations
- Policy making
- Monitoring and evaluation of the whole scheme
Local Offices of METI
- Registration
- Receipt and check of Periodical Reports
- Inspection (if necessary)
Designation for training and qualification role
Reporting
Energy Conservation Center, Japan (ECCJ)
-Provision of training program
-Qualification of Energy Manager
Registration of designated business site and qualified Energy Manager
Submission of Periodical Reports at June
Inspection if the site is judged as poor management
Dispatching candidates of Energy Manager
Qualification and certificate of license
Designated Organizations
- Assignment of candidates of Energy Manager and dispatching them to training program for qualification
-EE&C activities initiated by the qualified Energy Manager
- Making Periodical Reports (EE&C Results Report and Middle-Term Plan Report) (1 year cycle)
-Submission of Periodical Reports to Local Office of METI
Target 1: Annual 1% improvement of energy intensity is required!
Target 2: Benchmark for Specific 6 Sectors

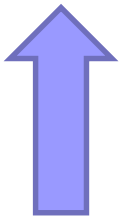
Samples of Benchmark in Specific Sectors

Sub-sector	Target Value	Average of All the Companies (2013)	Achieved Companies (2013)
Iron business using blast furnace	0.531 kl/ton	0.588 kl/ton (3 companies)	0
Normal Steel business using electric furnace	0.143 kl/ton	0.173 kl/ton (32 companies)	5
Special steel business using electric furnace	0.36 kl/ton	0.57 kl/ton (19 companies)	5
Power generation business	100.3 % for Rated Capability	99.0 % (11 companies)	0
Cement business	3,891 MJ/ton	4,190 MJ/ton (17 companies)	5

Benchmark is adopted for 10 fields in 6 sectors (Steal, Power Generation, Cement, Paper, Oil Refinery, and Chemical).
Top 10%-20% is set for the target value.

Achievement Records of Designated Organizations in Japan

Improvement



Change of Energy Intensity /Year (5 years average)	Number of Companies
Above 25 % Reduction	26 (0.2 %)
20 % - 25 % Reduction	40 (0.4 %)
15 % - 20 % Reduction	77 (0.7 %)
10 % - 15 % Reduction	315 (3.0 %)
5 % - 10 % Reduction	1,626 (15.3 %)
1 % - 5 % Reduction	4,640 (43.7 %)
0 % - 1 % Reduction	1,212 (11.4 %)
Total	7,936 (74.7 %)

Deterioration

Change of Energy Intensity /Year (5 years average)	Number of Companies
0 % - 5 % Increase	2,262 (21.3 %)
5 % - 10 % Increase	291 (2.7 %)
10 % - 15 % Increase	68 (0.6 %)
15 % - 20 % Increase	29 (0.3 %)
Above 25 % Increase	34 (0.3 %)
Total	2,684 (25.3 %)

* Data from the Periodical Reports in 2013

(Source: METI)

Evaluation of Designated Organizations

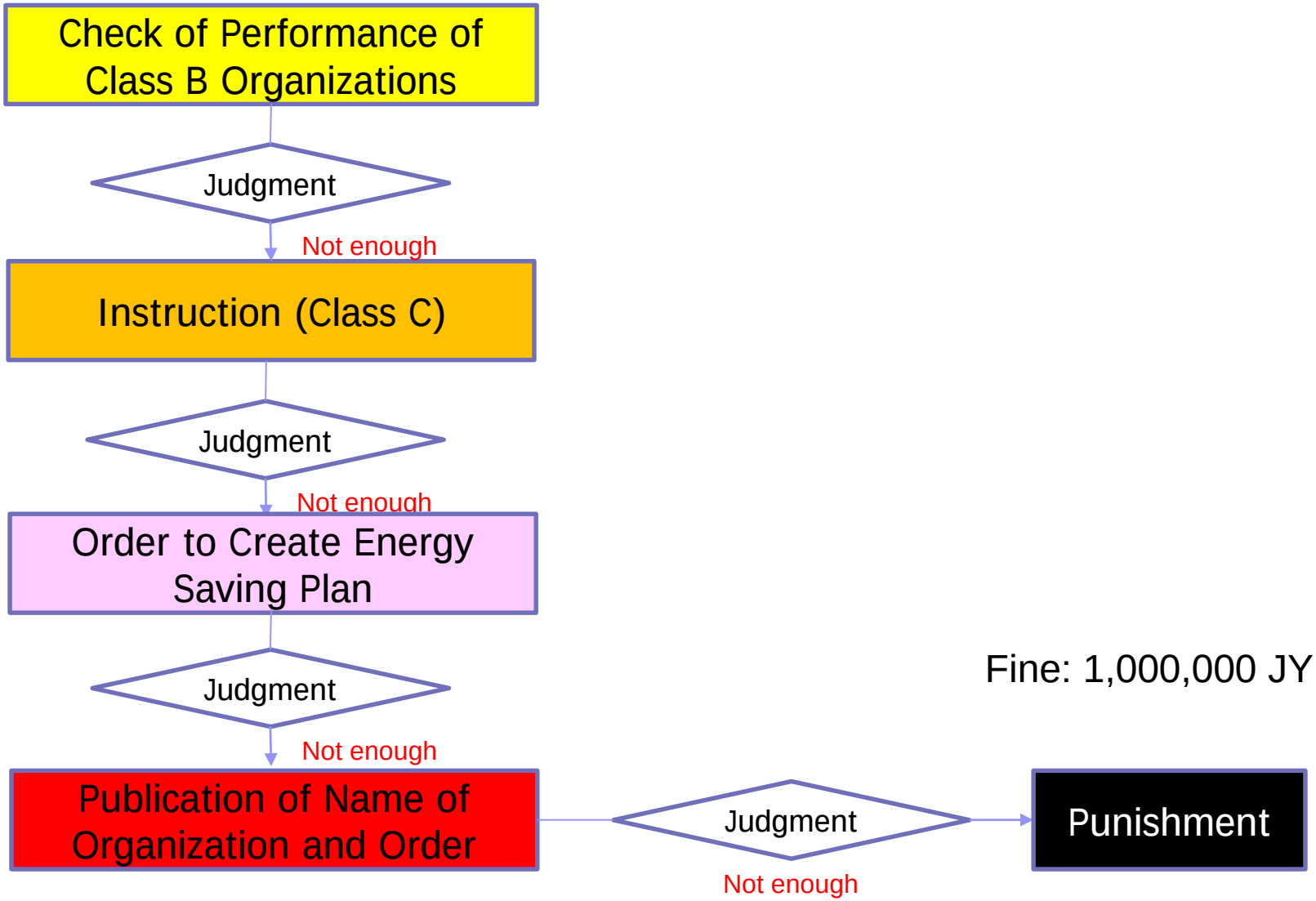
- Based on the submitted Periodical Reports, all the organizations are categorized into 4 classes and METI takes actions by class.

Class S	**Class A**	**Class B**	**Class C**
Good Performers 6,734 Organizations (54.6 %)	Normal Performers 4,240 Organizations (34.4 %)	Non-Achieved Performers 1,364 Organizations (11.1 %)	No Good Performers
(Standard) (1) Achievement of Energy Intensity Target or (2) Achievement of Benchmark Target (METI's Actions) METI publishes the name of organizations as good performers	(Standard) Organizations which are not categorized into Class S, Class B nor Class C. (METI's Actions) No action is taken.	(Standard) (1) Not achievement of Energy Intensity Target and increase the Energy Intensity in 2 consecutive years or (2) More than 5 % increase of Energy Intensity in 5 years average (METI's Actions) METI sends a letter to the organization and visit the site to check.	(Standard) (1) Organizations of Class B and (2) Not compliance with judgment criteria (METI's Actions) METI gives an instruction based on the law.

* Data from the Periodical Reports in 2013

(Source: METI)

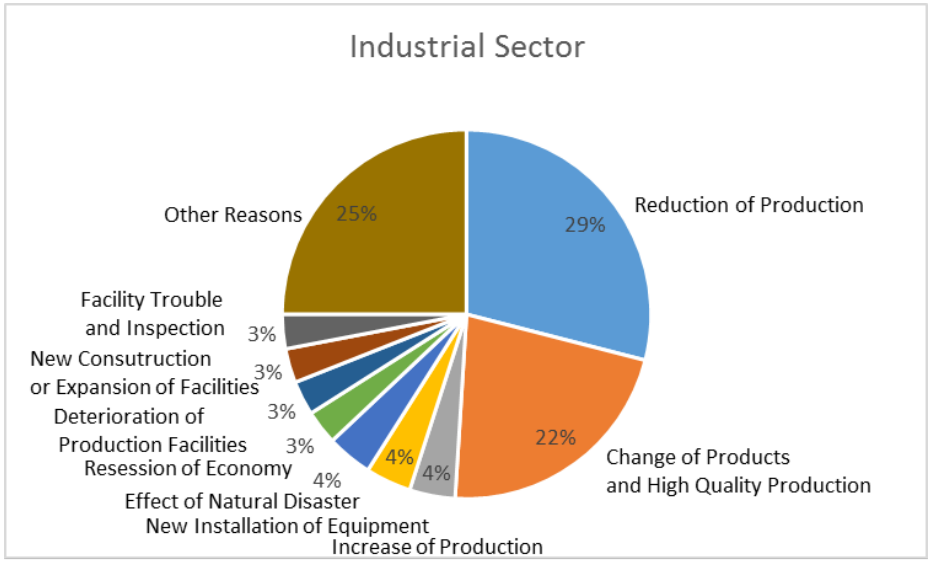
METI's Actions for Class C



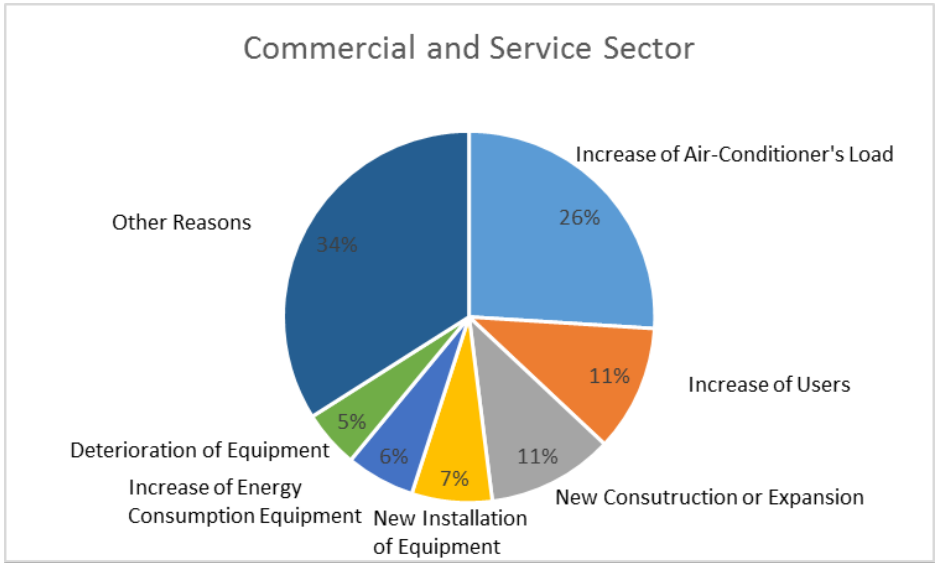
Fine: 1,000,000 JY

Reasons why Organizations did not Achieve the Target of 1 % Improvement of Energy Intensity

- Organizations which does not achieve the target of 1 % improvement of Energy Intensity have to describe reasons in Periodical Report.
- For the Industrial Sector, reduction of production and change of products and high quality production are major reasons.
- For the Commercial and Service Sector, increase of air-conditioner's load, increase of users and new construction and expansion are major reasons.



446 Samples in 2014

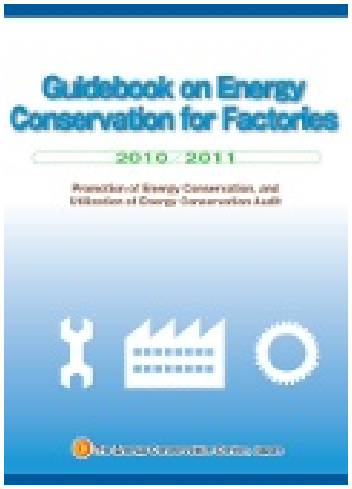


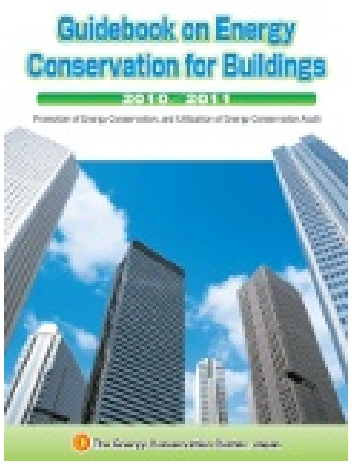
217 Samples in 2014

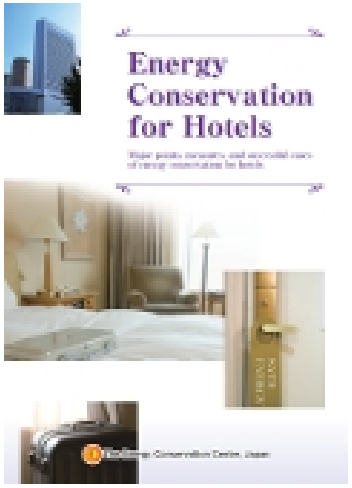
(Source: METI)

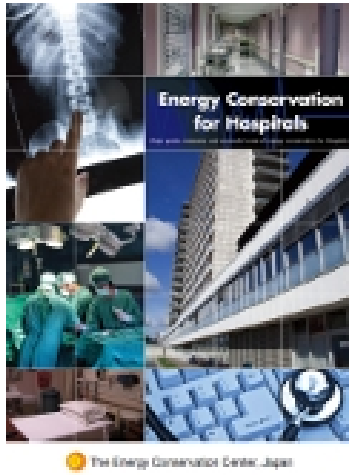
* Multiple answer is possible

Brochures for Energy Conservation









一般財団法人省エネルギーセンター
The Energy Conservation Center, Japan

http://www.asiaeec-col.eccj.or.jp/brochure/index.html

3. Japanese Technology for Energy Efficiency

Ultra Super Critical Coal Power Generation

Effect

- Improvement of thermal efficiency (43% HHV)
- Reduction of CO^2 emission

Location	Boiler Contractor	Turbine/ Generator Contractor	Capacity (MW x unit)	Construction	First operation
Hitachinaka #1	BHK	HTC	**1000 x 1**	12/1998 - 12/2003	12/2003
Hirono #5	MHI	MHI/ME	**600 x 1**	7/2000 - 7/2004	7/2004

Specification	Main steam Press (MPa)	Main steam Temp (℃)	Reaheater Temp (℃)	Efficiency (%, HHV)	Fuel
Hitachinaka #1	24.5	600	600	43.1	Coal
Hirono #5	24.5	600	600	43.0	Coal

TEPCO Hitachinaka Power Station

<General Feature>

- Construction Cost: Approximately 1,400 US$/kW including environmental facilities (excluding port facilities and land acquisition)
- Scale of Unit: 500 MW-1,000 MW per Unit
- Water Content: Less than 30%
- Coal Type: Better than Sub-bituminous
- Ash Melting Point: More than 1,200 C
- Ash Content: Less than 10%

More Advanced Combined Cycle (1,500°C-class Gas Combined Cycle Power Generation)

Effects

- Improvement of thermal efficiency (59% LHV)
- Reduction of CO^2 emission

● Gas turbine ----------

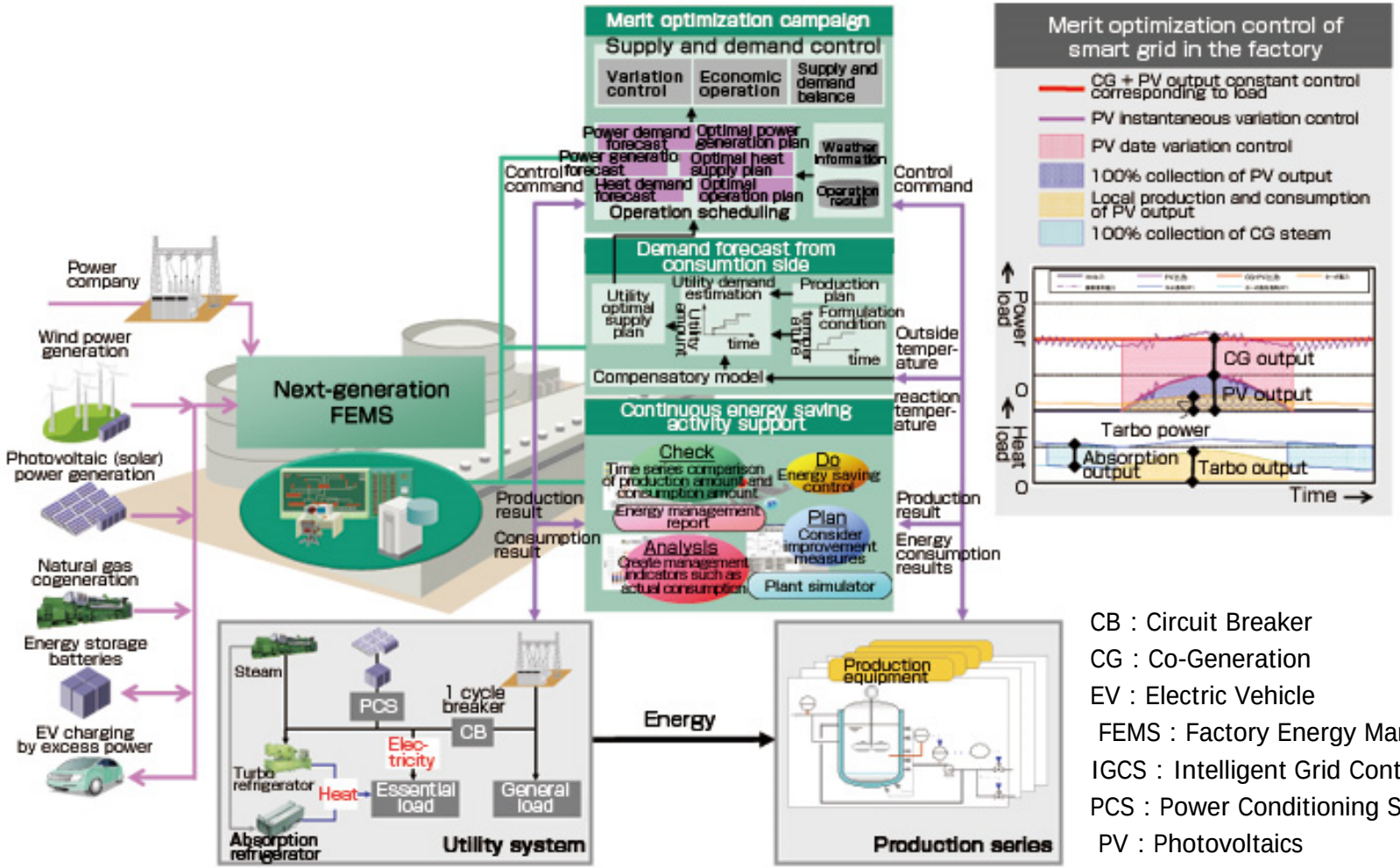
Model:	Open cycle single-shaft type
Output:	Approx. 330 thousand kW (air temperature of 5°C)
Inlet gas temperature:	Approx. 1,500°C
Pressure ratio:	Approx. 21
Combustor:	Premixed combustion type
Fuel used:	Re-gasified LNG

● Steam turbine ----------

Model:	Three-pressure reheated double-flow exhaust condensation type
Output:	Approx. 170 thousand kW (air temperature of 5°C)
Steam pressure:	High pressure ... Approx. 13 MPa Medium pressure ... Approx. 3 MPa Low pressure ... Approx. 0.4 MPa
Steam temperature:	High pressure ... Approx. 560°C Medium pressure ... Approx. 570°C Low pressure ... Approx. 270°C

TEPCO Kawasaki Power Station

Factory Energy Management System



CB : Circuit Breaker
CG : Co-Generation
EV : Electric Vehicle
FEMS : Factory Energy Management System
IGCS : Intelligent Grid Control System
PCS : Power Conditioning System
PV : Photovoltaics

(Source: HITACHI)

Amorphous Core Transformer

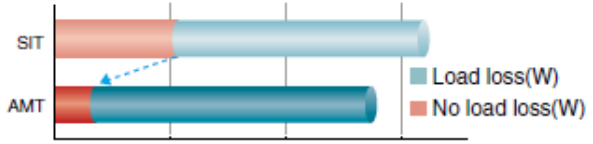
About the loss of transformers

No Load Loss (Iron loss)
The constant loss that always occurs regardless of whether loaded or not.

Load Loss (Copper loss)
The loss occurs because of the flow of load current when loaded.

- Reductin of No Load Loss
- Reductin of Load Loss

→ **Energy Saving**
→ **CO_2 Reduction**



Amorphous Transformer is the Solutions

Case Study

Case Study (Nakajo Works)

Transformer Characteristics

	No Load Loss (W)	Load Loss (W)
25 years Old SiT	1,800	11,300
AMT	350	9,750

- 50% Load Factor - JPY11/kWh - CO_2 emission coefficient 0.444 (kg-CO_2/kWh)

Annual Loss of Electricity Cost (money amount/year)

SiT: 〈 1,800 (W) + 11,300 (W) × 0.5^2 〉/1,000 × 365 (days) × 24h × 11 (JPY/kWh)/1,000 = 446 (k JPY/year)

AMT: 〈 350 (W) + 9,750 (W) × 0.5^2 〉/1,000 × 365 (days) × 24h × 11 (JPY/kWh)/1,000 = 269 (k JPY/year)

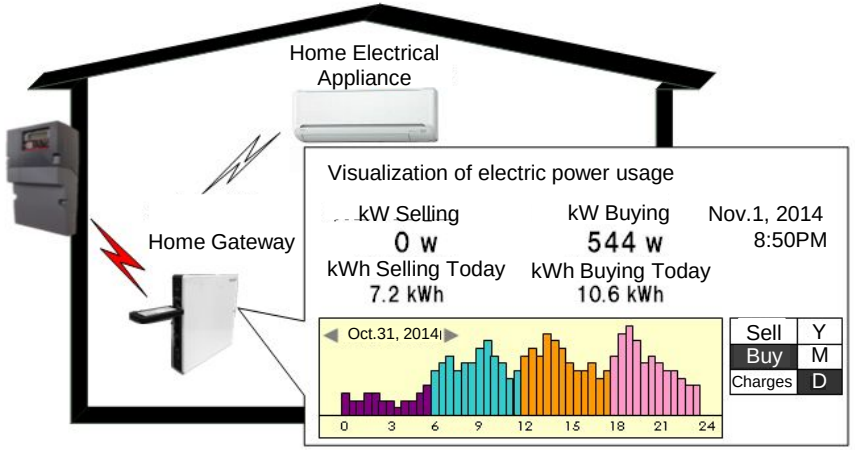
➡ **Great Cost Saving Effect :** 446 (k JPY/year) − 269 (k JPY/year) = 177 (k JPY/year)

(Source: Hitachi Industrial Equipment Systems)

Smart Meter (2 way communication power meter)

Deployment of Smart meters

- By FY 2020, TEPCO will install 27 million smart meters throughout its entire customer area
- Early realization of new rate menu and lifestyle-enhancing services
- Early realization of management rationalization, such as automatic metering, elimination of field visits and reduction of investment via demand response, etc.



Advanced services using meter data

- Smart meter transmits metering data to HEMS at customer's home
- Efficient energy savings using HEMS, which reads the amount of electricity and current every 30 minutes

Hvala