ECAP 14

Energy Conservation Benchmark System in Japan

ASEAN

METI

ECCJ

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Contents

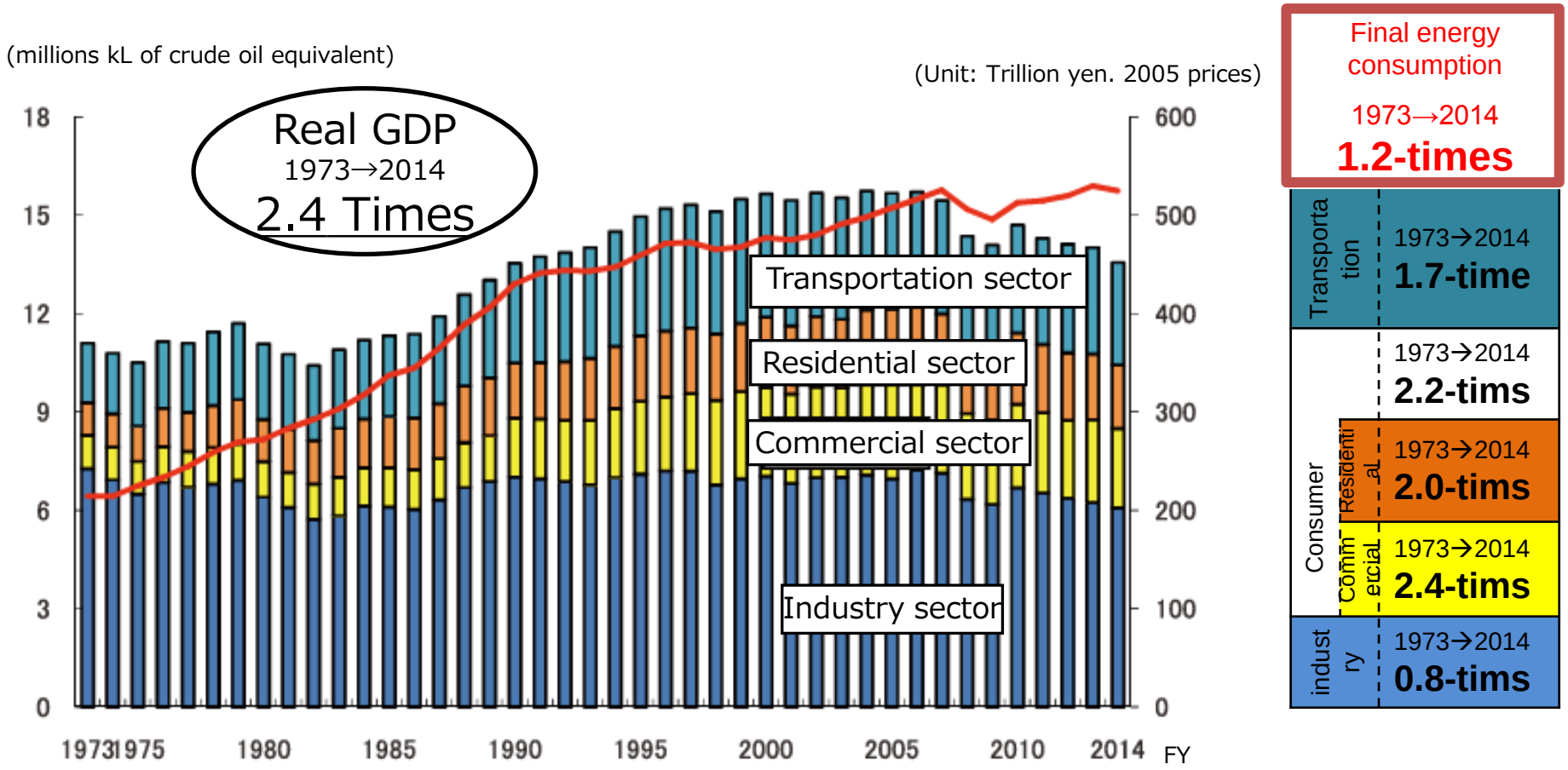
1. Introduction

The Energy Conservation Law has Important Role for Promotion of Energy Conservation for Buildings in Japan

1. 1 Introduction

Transition of Final Energy Consumption in Japan (1973-2014)

- The GDP grew 2.4 times from 1973 to 2014. As for the energy consumption of , it increased by 2.4 times in the commercial sector, 1.7times in the transportation sector, almost 0.8 time in the industrial sector.



History of Energy Conservation Law in Japan in terms of regulation on Industrial Sector

1920~ Coal Conservation Movement in Osaka Pref.

1947 Heat Management Regulation enacted

1951 Heat Management Law enforced

1973 1st Oil Crisis

1979 Energy Conservation Law enforced

1979~80 2nd Oil Crisis

1993 Energy Conservation Law revised

1997 COP3 (Kyoto Protocol)

1998 Energy Conservation Law revised

2002 Energy Conservation Law revised

2005 Kyoto Protocol into effective

Energy Conservation Law revised

2008 Energy Conservation Law revised

2008~2012 Kyoto Protocol 1st Period

2013 Energy Conservation Law revised

2017 New EC law for Building & mandatory standards

Effective use of Fuel in Industrial Sector (Big Factories)
Designated Factories (Heat), Assignment of Heat Management Manager, Fuel Record Obligation

Effective use of Fuel and Electricity in Industrial Sector
・**EC Guideline**, Designated Factories (Electric), Energy Management Manger, Energy Record Obligation>

Strengthening of regulation on Industrial Sector
EC Guideline target section, Obligatory Periodical Report

Widening of regulation (Mid-size factory & Commercial Str)
・Type-1 DFs : Obligatory Mid-Long Term Plan
・ Type-2 DFs : Ty2 Energy Manager, Record Obligation

Strengthening of regulation on Commercial Sector
・ Type-1 DFs : Commercial Sector Added
・ Type-2 DFs : Obligatory Periodical Report

Strengthening of regulation
・Integration of Heat and Electricity
・**EC Guideline modified accordingly**

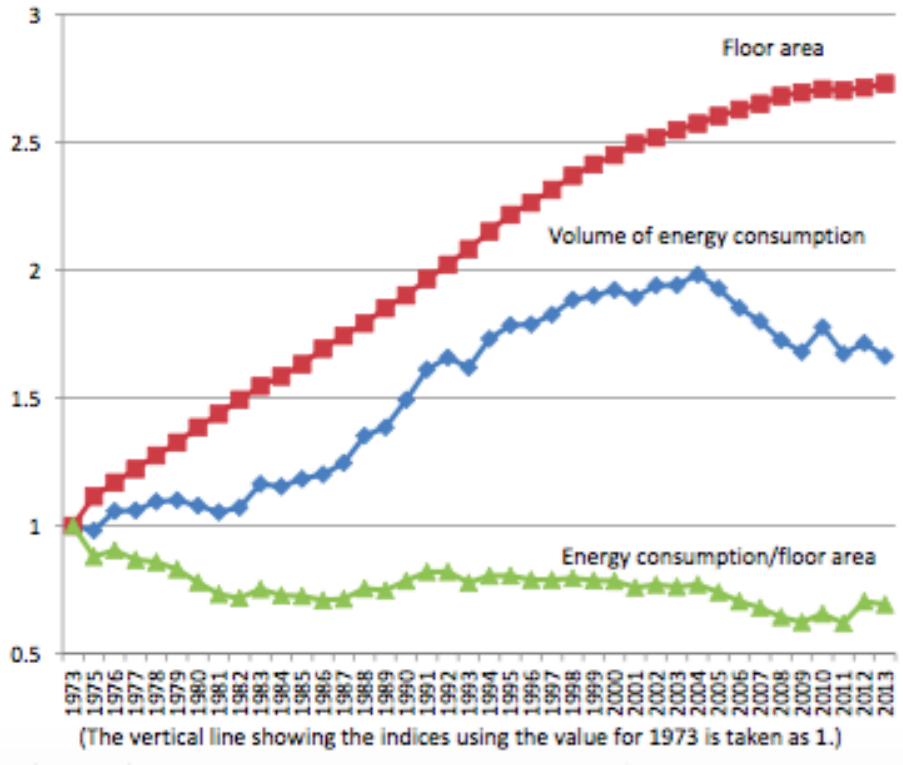
Strengthening of regulation
・Regulation on Business Entity (not Factory)
・**Bench Mark introduced as a part of EC Guideline**

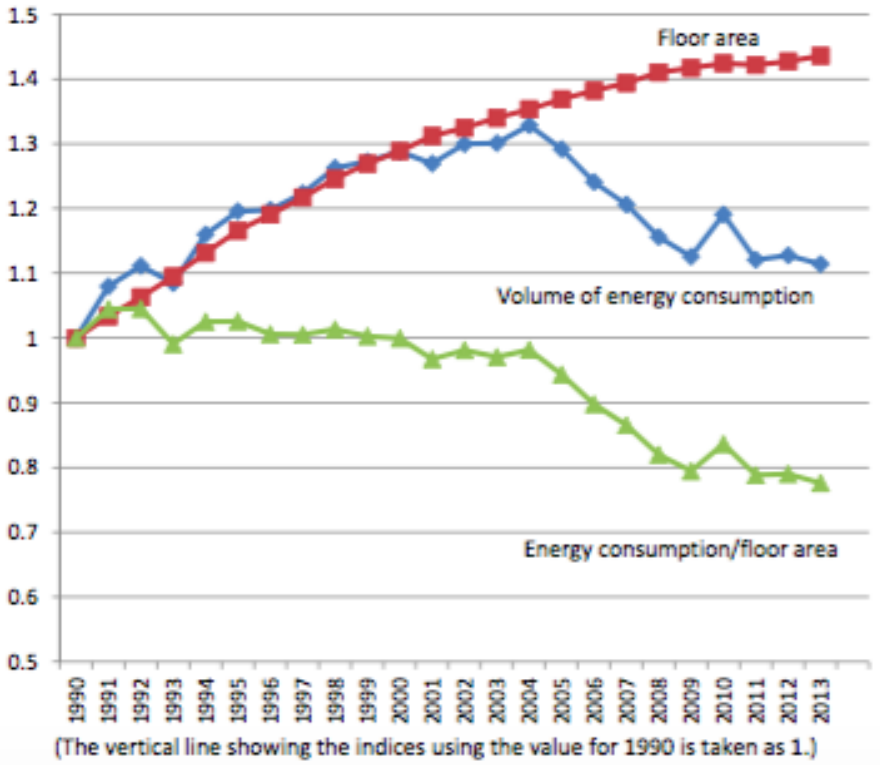
Strengthening of regulation
・EC Building Code modified and strengthened

Situation of energy consumption in the commercial sector

- As for the commercial sector where energy consumption has considerably increased, energy consumption “per square meter” has been leveling off or even improved in recent years.
- Although the floor area has been consistently on the rise, energy consumption has been declining in recent years.

Evolution of energy consumption and floor area in the commercial sector





(Sources) Prepared on the basis of *the Handbook of Japan's & World Energy & Economic Statistics* issued by the Institute of Energy Economics, Japan.

1.2 Overview of the Energy Conservation Law and the Related Regulations on Buildings

Obligation of the Building Owners under the Energy Conservation Law

Design	Construction	Operation	Renovation
			

For Design and Maintenance

Buildings having total floor area 300 m2 or larger

Before construction	After operation start	Submission of the notification of energy saving measures to the competent authority (local government) before extensive renovation
compliance to the EC standard (guideline) specified in the EC law (2000m2 and more) Notification of energy saving measures to the competent authority (local government)	Submission of periodical maintenance report to the competent authority (local government)	

Implemented by the Local Government

For Operation

Specified Business Operator classified by annual energy consumption:

1500kL(oe) or more

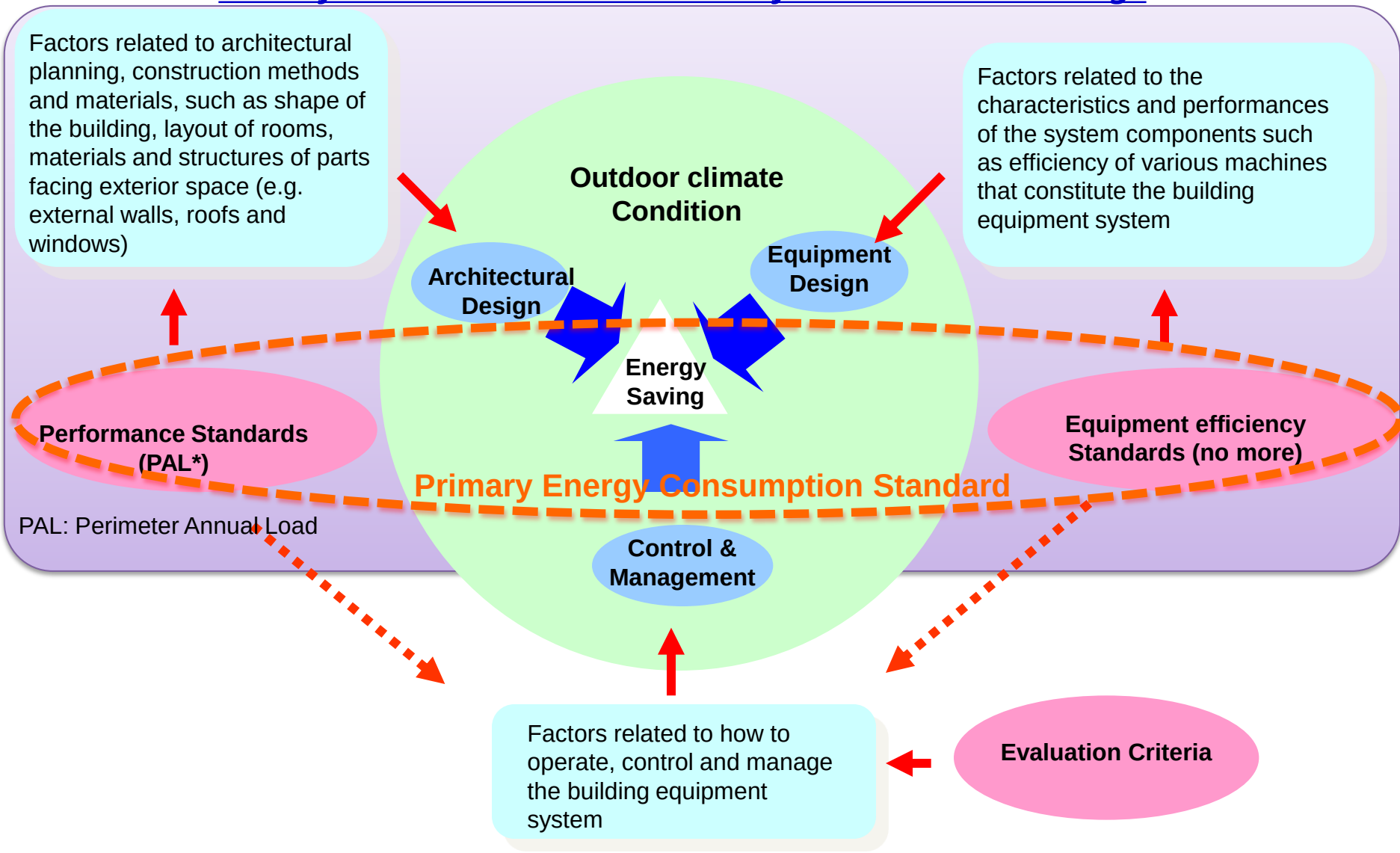
Designated EM Factory
Type 1: 3000kL(oe) or more
Type 2: 1500kL to 3000kL(oe)

- Energy management control officer is selected from executives.
- Energy management planning promoter to support energy management control officer is selected.
- Energy managers(Type 1 or Type 2) are selected for each designated energy management factory.
- Submission of medium and long-term plan and periodical report by each company.

Implemented by METI

The Related Regulations on Buildings (new Building Code)

Three factors and the Standards of the EE&C in buildings



Fixed an architecture for a sustainable future（IBEC)

2. Overview of the Energy Management System in Japanese Energy Conservation Law

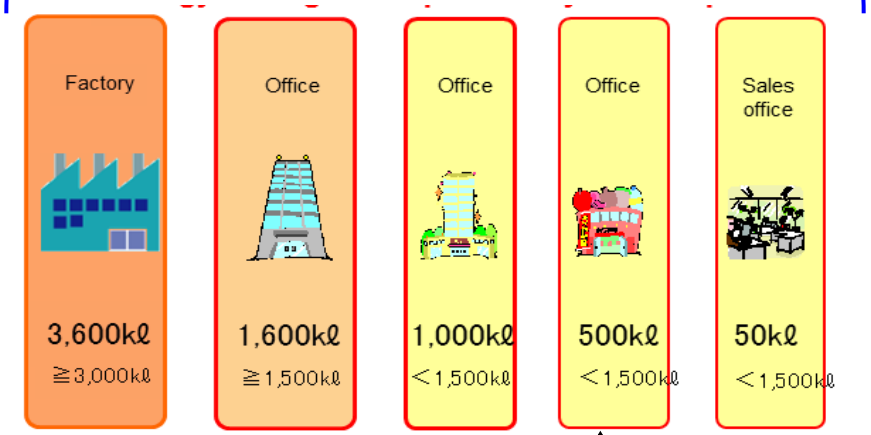
1.3 EC ACT for Operation of Buildings

EC Act Revision in 2008

Energy management by each factory/building by a whole enterprise

Before revision

ABC Co., Ltd.



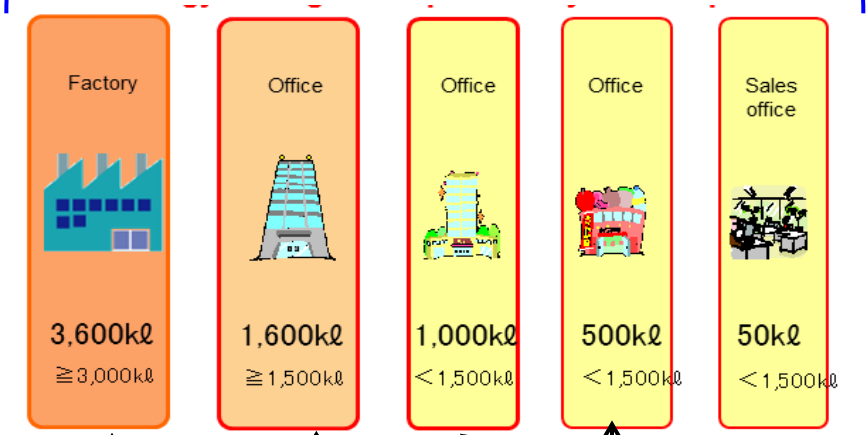
Specified as Type 1 Designated Energy Management Factories, etc.

Specified as Type 2 Designated Energy Management Factories, etc.

Not specified

After revision

ABC Co., Ltd.



Specified as Type 1 Designated Energy Management Factories, etc.

Specified as Type 2 Designated Energy Management Factories, etc.

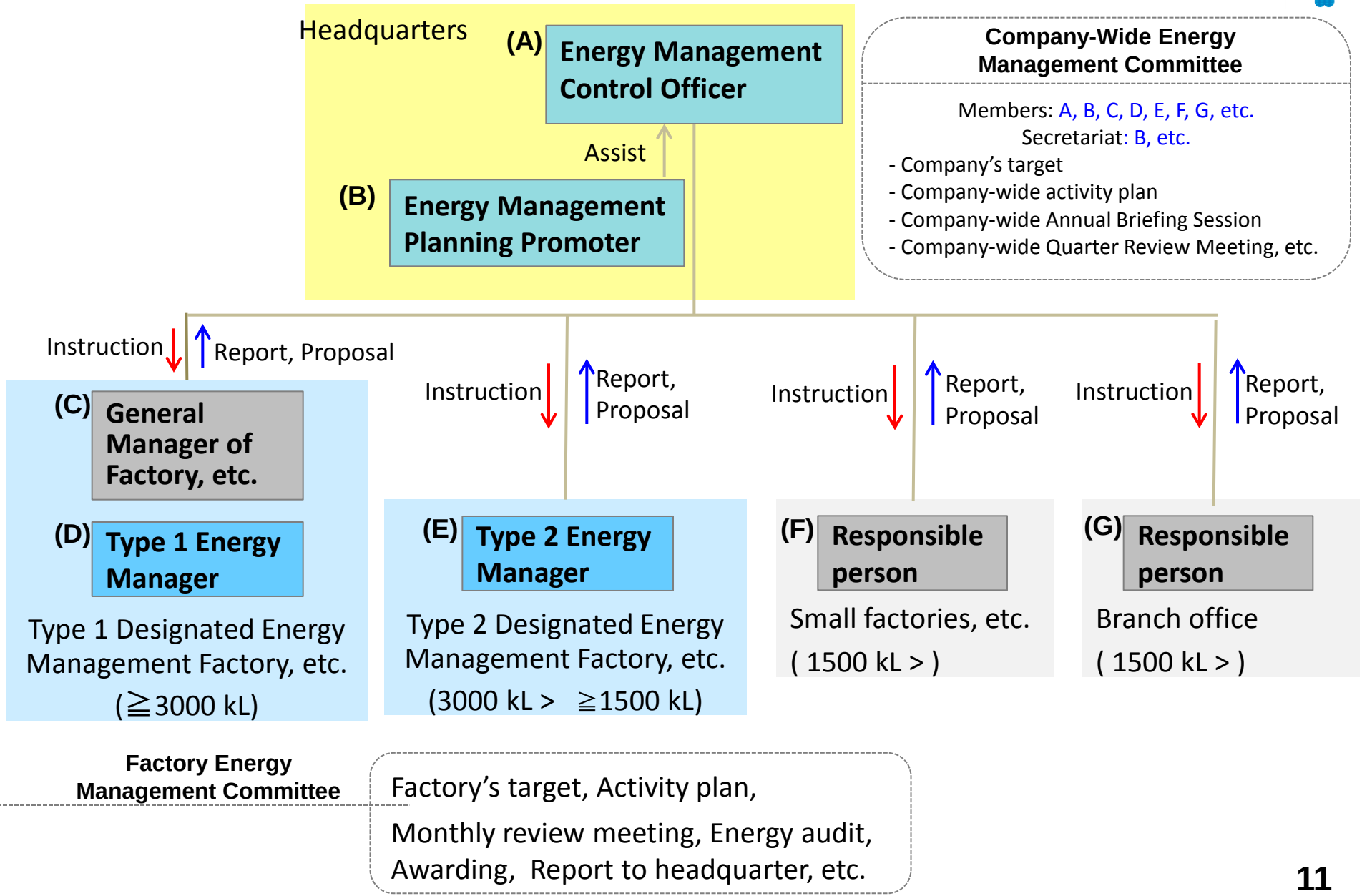
Not specified

Revised

Total energy consumption: 7200kL (≧1500kL)

Specified as Specified Business Operator

Organization Chart of Energy Management



Energy Management System under Japanese EC Act

"Energy Manager" and "EC guideline" to be Key factors to promote EC

Government (METI) and EC Act

Submission of periodical report and mid-long term EC plan ↑

↓ Authorization of energy manager

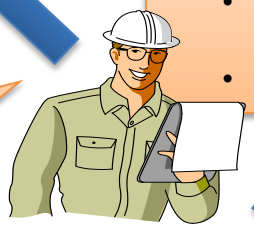
Designated business operator

Top Management

Advising on,
- Improvement plan EE equipment
- Management of EE & C Organization

Registered Energy Manager

- Making Periodical Report and Mid-long Term plan
- Keeping the energy consuming facilities in sound condition
- Carrying out "Energy Audit"



Practical guideline to support Energy management

- ❑ EC Guidelines (Mandatory)
- ❑ Energy Management Manual
- ❑ Numerical target of major energy intensity equipment

·Instruction
·Technical Advice

Engineers
(Middle Management)

EC Guideline and Energy Management (EM) Manual

Provision by Government

EC Guideline

Standards and technical/ administrative viewpoints are prescribed to improve EC performance of equipment / system

"Guideline" for Energy Managers

EM Manual

In-house technical standard or a set of rules to realize EE&C of equipment/ system

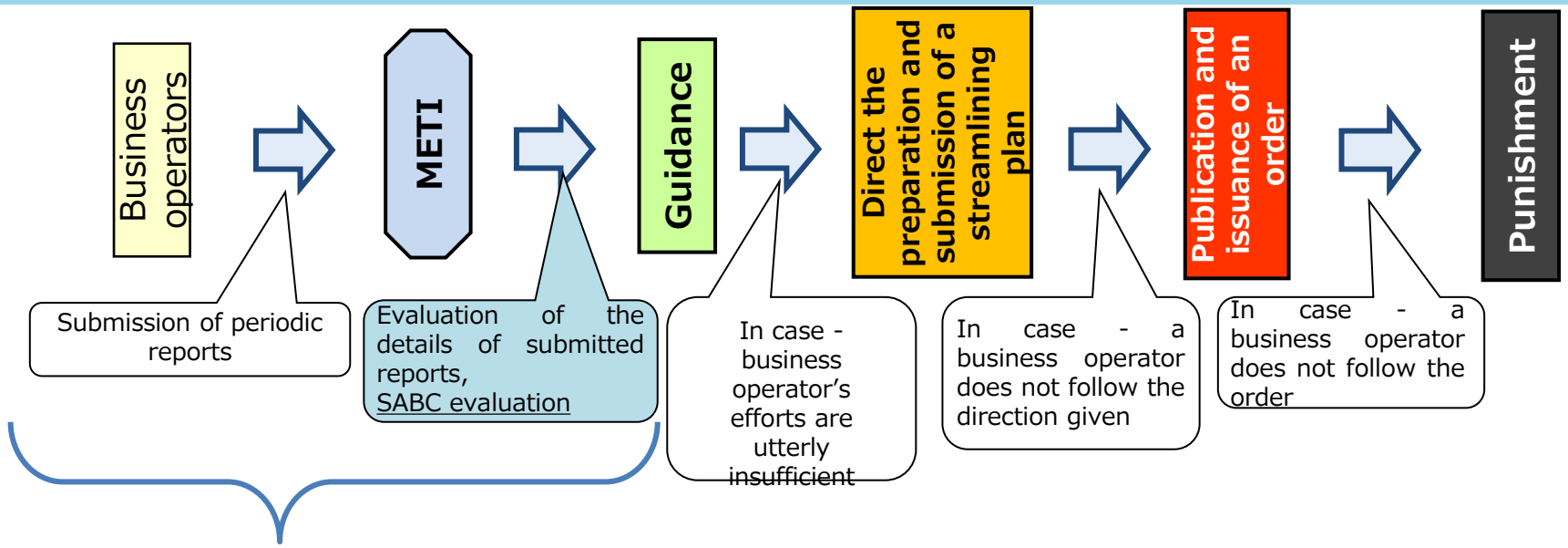
Preparation by business operators

Operation Manual, etc.

Workers shall abide by the EM standard and operation manuals.

Report to government with energy efficiency activities

■ The Act requires business operators to report their activities on energy efficiency to the government that evaluate them with the report.



< Matters to be stated in periodic reports >

- **Implementation status of energy conservation measures**
- **Changes in specific energy consumption**
- **Status of the benchmark indices (for only applicable types of business)**

○**Judgement on standards for energy efficiency measures (**Matters to be observed concerning business operators' management systems and management methods of individual devices

○**Non-binding target (**Reduction by 1% or more on an annual average basis)

○ **Benchmark index/target levels (**for several business sectors (e.g. manufacture of steel, power supply, manufacture of cement, manufacture of paper, petroleum refinery, and manufacture of chemicals)

Evaluation system for business operators classification

■ All business operators that submit periodic reports are classified into four classes (SABC), and relevant measures would be taken for each categories.

Class S	Class A	Class B	Class C
Business operators **excellent in energy conservation efforts** 7,774 companies (62.6%) *1	Business operators not in Class S, B or C 3,417 companies (27.5%) *1	Business operators whose energy conservation efforts are not progressing 1,221 companies (9.8%) *1	Business operators who need close monitoring
[Levels] (i) Having achieved the annual improvement target*2 or (ii) Having achieved the benchmark target*3 [Measures] The name and number of years of the class S accomplishment **are publicized on the METI website to praise the business operator as an excellent one.**	[Levels] Not falling under Class S nor Class B [Measures] No particular measures are taken.	[Levels] (i) Having failed to achieve the non-binding target and increased specific energy consumption from the preceding year for two years in a row or (ii) Having increased specific energy consumption by 5% or more on average for five years [Measures] A written notice is sent and on-site inspections, etc. are conducted intensively.	[Levels] Among business operators classified into Class B, those that are especially bad at complying with judgment standards [Measures] Guidance based on Article 6 of the Act on the Rational Use of Energy is provided.

*1 Calculated based on the total number of business operators that have submitted periodic reports in FY2015 (regarding performance in FY2014) (12,412 companies)
*2 Improvement target: Reduction of specific energy consumption by 1% or more on average for five years
*3 Benchmark target: Levels to be aimed at in the medium- and long-term in business types and fields covered by the Benchmark System

[Reference] Compliance in Each Sector in the Previous Fiscal Year

The Commercial Sector has more S Class business operators and less proportion of B Class business operators compared to the Industrial Sector.

*Periodical reporting in FY2015 (Actual results from FY2014)

		S Class		A Class		B Class	
		No. of business operators	Proportion	No. of business operators	Proportion	No. of business operators	Proportion
All business operators	12,412	7,775	62.6%	3,430	27.7%	1,207	9.7%
Industrial Sector	6,259	3,240	48.9%	2,182	37.6%	837	13.5%
Commercial Sector	6,153	4,535	73.7%	1,248	20.3%	370	6.0%

3. Energy Conservation Benchmark System in Japan

3.1 Overview of the Benchmark System in Japan

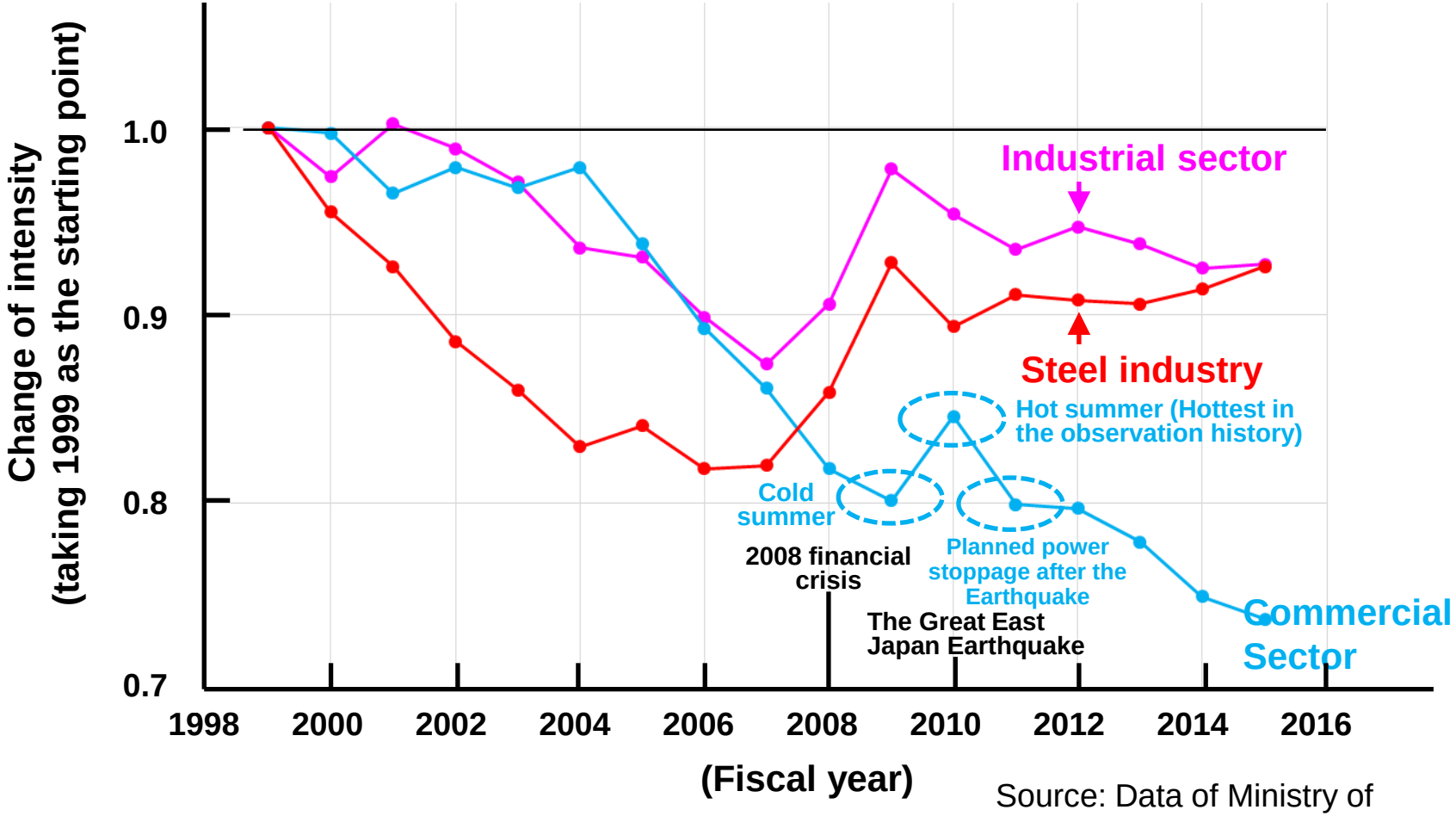
3.2 Benchmark System in Commercial Sector

3.3 Proposed Benchmark Standard of Hotels

3.1 Overview of the Benchmark system in Japan

Current State of Energy Conservation in Japan

- As far as the change of the intensity is concerned, it is sluggish in the entire industrial sector, but it is smoothly decreasing in the entire commercial sector in spite of external disturbances.



Source: Data of Ministry of Economy, Trade and Industry

Problem Awareness in the Energy Conservation

- It became difficult to continue decreasing the energy consumption intensity by 1% or more in yearly average.
- Superior business operators who had already achieved considerable energy conservation are not appropriately assessed because it became difficult for them to achieve 1% decrease.

Benchmark system started to be studied as a new assessment index.

2008: Benchmark system stated to be studied

Benchmark system assesses energy conservation of business operators by using indices common to the business types. Under the benchmark system, business operators endeavor to achieve the target (level to be aimed at) to realize energy conservation.

2009: Committee for studying benchmark system

2009-2010: Industry sector Benchmark system was introduced.

<Business types which started to study introduction in the commercial sector>
6 business types were chosen because their energy consumption and concentration are great.
(1) Convenience store (2) Hotel (3) Department store (4) Lease office (5) Supermarket (6) Shopping center

<Industry sector: 6 business types 10 fields>
(1) Steel industry by blast furnaces
(2) Ordinary steel manufacturing industry by electric furnaces
(3) Special steel manufacturing industry by electric furnaces
(4) Electric utility industry
(5) Cement manufacturing industry
(6) Paper manufacturing industry
(7) Paperboard manufacturing industry
(8) Petroleum refining industry
(9) Basic petrochemicals manufacturing industry
(10) Soda industry

2014: Benchmark system for the commercial sector started to be studied on a full-scale at the committee for studying assessment system for energy conservation of the commercial sector

August, 2015: At the summary of Energy Efficiency and Conservation Subcommittee, it was decided that "a benchmark system for the commercial sector should be established".

November, 2015: Prime Minister Mr. Abe instructed to expand the benchmark target business in the commercial sector.

April, 2016: Benchmark system was introduced to the convenience store business.
* Introduced as the first business from the commercial sector

Source: Data of Ministry of Economy, Trade and Industry

Achievement of Reduction of Energy Consumption Intensity by 1% in Yearly Average

- Business operators who has not achieved "1% reduction of energy consumption intensity in yearly average in a medium to long term" account for 1/3 of the whole. Many of them are in the manufacturing industry.

Yearly average change ratio of energy consumption intensity		Ratio of relevant business operators		Industries which continuously reduced the intensity for 3 years	
Improved	Reduced 25% or more	0.2%	63.3%	・Broadcast: 60% ・Video, audio, characters, information production: 59% ・Various commodity retailing: 54% ・Information service business: 52% ・Food and beverage retailing: 51%	・Railway: 50% ・Religion: 50% ・Furniture, fixture manufacturing : 47% ・Banking: 44% ・Food and beverage wholesaling: 44%
	Reduced 20 - 25%	0.4%			
	Reduced 15 - 20%	0.7%			
	Reduced 10 - 15%	3.0%			
	Reduced 5 - 10%	15.3%			
	Reduced 1 - 5%	43.7%			
Not achieved	Reduced 0 - 1%	11.4%	36.7%	・Mining, quarrying, gravel extraction: 24% ・Electronic parts, devices, electronic circuit manufacturing: 17% ・Beverage, tobacco, fodder manufacturing: 16% ・Rubber product manufacturing: 16% ・Chemical industry: 16%	・Ceramic, soil and gravel product manufacturing: 16% ・Non-ferrous metal manufacturing: 16% ・Electricity business: 15% ・Transportation machine manufacturing: 15% ・School education: 15%
	Increased 0 - 5%	21.3%			
	Increased 5 - 10%	2.7%			
	Increased 10 - 15%	0.6%			
	Increased 15 - 20%	0.3%			
	Increased 20% or more	0.3%			

(Note) The foregoing is the result of the analysis conducted based on the periodical reports of the recent 5 years (FY2009 to FY2013).

Source: Data of Ministry of Economy, Trade and Industry

Outline of Benchmark System

The benchmark system is meant to assess the energy conservation of business operators by using the index common to all business types and to promote energy conservation activities of each of the operators in an aim to achieve the target (level to be aimed at).

<Significance of introduction of the benchmark system>

- Business operators whose energy conservation activities were not appropriately assessed with the conventional index (reduction of 1% or more) alone can be appropriately assessed in terms of energy conservation by using the benchmark index.
- As the assessment is conducted by using an index common to all business types, energy conservation activities of business operators are objectively understood.

3 elements necessary for the establishment of the benchmark system

(1) Business	(2) Benchmark index	(3) Level to be aimed
Business types consuming energy with the same or a very similar method are set.	Assessment indices are set commonly for target business operators, considering the specialties of the target business.	High level to be achieved by target business operators in medium and long terms (top 10% to 20% of target business types) is set.

Business	Benchmark index	Level to be aimed at
Steel industry by blast furnaces	Energy consumption (kl) / Crude steel volume (t)	0.531 kl/t or less

Source: Data of Ministry of Economy, Trade and Industry

Achievement of Benchmark Index

The achievement ratios of the steel industry and the electric utility industry are both 0%, indicating severe situations.

		Level to be aimed at	Number of achievers	Number of reporters	Achievement ratio
1A	Steel industry by blast furnaces	0.531 kl/t or less	0	3	0%
1B	Ordinary steel manufacturing industry by electric furnaces	0.413 kl/t or less	5	32	16%
1C	Special steel manufacturing industry by electric furnaces	0.36 kl/t or less	5	19	26%
2	Electric utility industry	100.3% or more	0	11	0%
3	Cement manufacturing industry	3.891 MJ/t or less	5	17	29%
4A	Paper manufacturing industry	8.532 MJ/t or less	4	20	20%
4B	Paperboard manufacturing industry	4.944 MJ/t or less	5	31	16%
5	Petroleum refining industry	0.876 or less	4	13	31%
6A	Basic petrochemicals manufacturing industry	11.9 GJ/t or less	1	10	10%
6B	Soda industry	3.45 GJ/t or less	8	22	36%

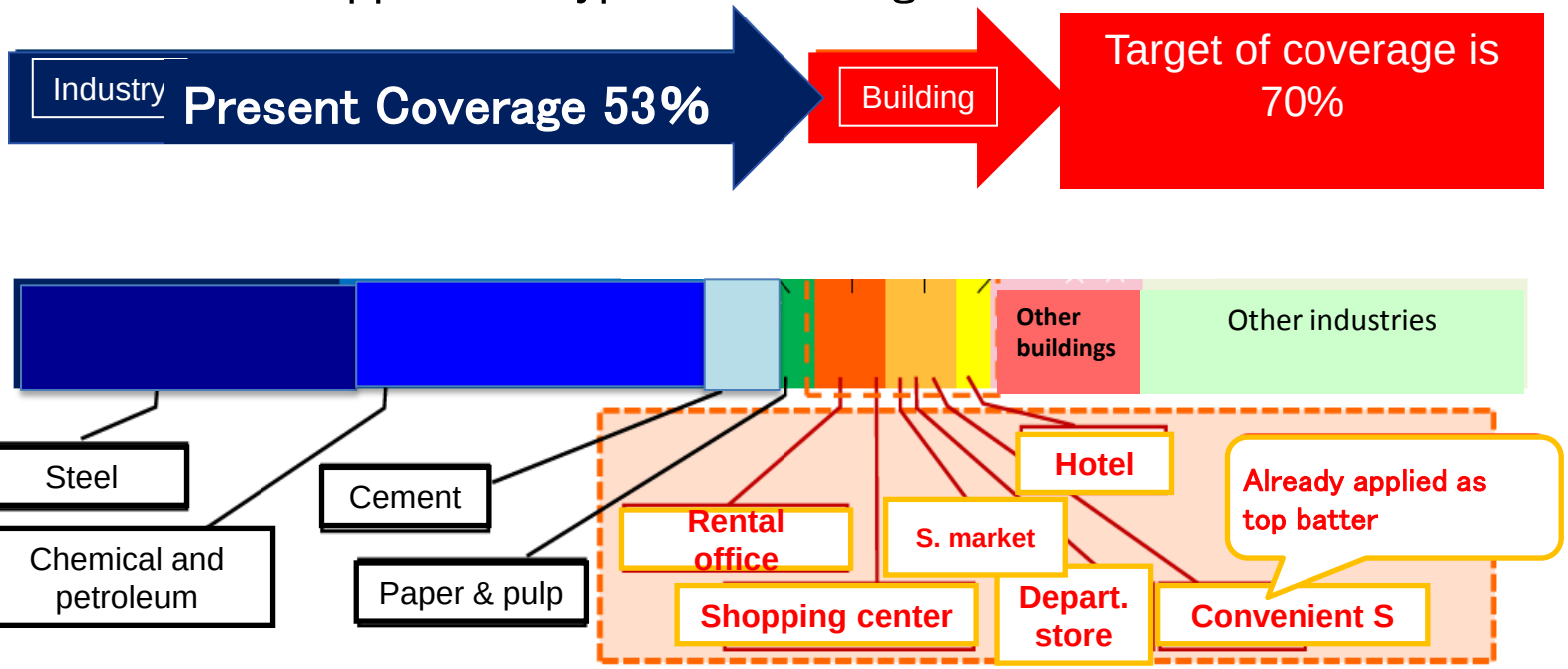
(Note) The foregoing is the result of the analysis conducted based on the periodical report of FY2013.

Source: Data of Ministry of Economy, Trade and Industry

Expansion of the Coverage of EE&C Benchmark System of EC Law in Building Sector in Japan

- In the first phase, the benchmark system will be introduced in six types of buildings and the coverage will become 65%.
- In the second phase, it will be applied to schools and hospitals and the coverage will be expanded to 75%

→Introduce to the applicable types of buildings first



Six types of Building

出典:経済産業省資料

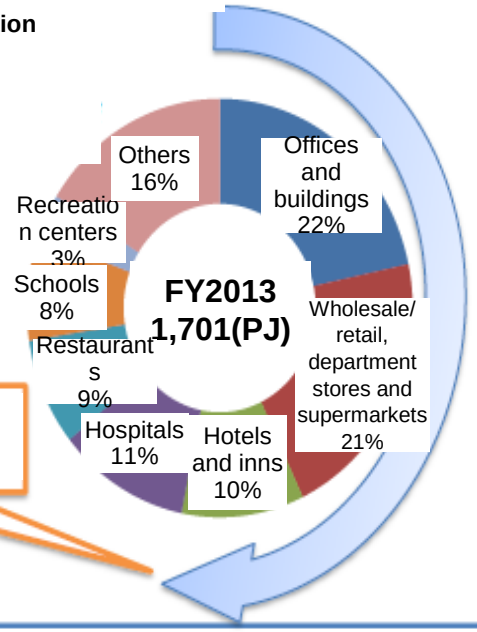
3.2 Benchmark System in commercial Sector in Japan

Study of Benchmark System to be Introduced into Commercial Sector

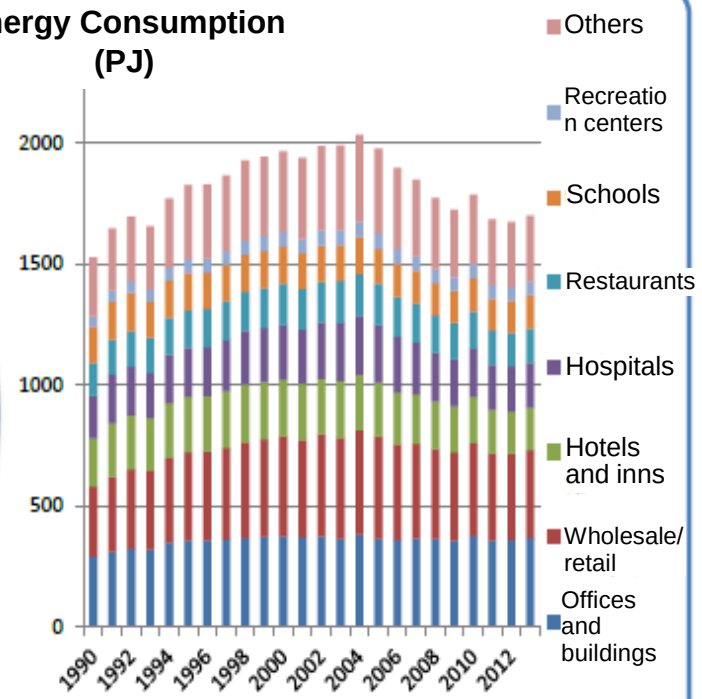
- As the total floor area of the commercial sector increased, the energy consumption of the sector continued to increase, but it peaked out in 2004 and started to decrease.
  → The benchmark system is applied to the commercial sector as well to increase the coverage ratio.

Organizations with which the workshop has studied the assessment indices and levels

- **Japan Chain Stores Association**
- **Japan Department Stores Association**
- **Japan Building Owners and**
- **Japan Franchise Association**
- **Japan Hotel Association**
- **The Real Estate Companies Association of Japan**



Approx. 50% of the commercial sector is covered.



Source: Data of Ministry of Economy, Trade and Industry

Benchmark System in Building Sector

- Benchmark index is the energy consumption of the concerned building divided by the average energy consumption of the sampled buildings of the category which the concerned building belongs to.
- The standard level is determined based on that 10%-20% of the buildings of the concerned category can satisfy the level.
- According to the feature of the buildings, the parameters correlated with energy consumption are different according to the type of buildings. For example, for convenient stores, each store is identical, but for the rental office buildings, the energy consumption is of uneven because the tenants varies widely.
- In consideration of these circumstances, three kinds of approaches shown below are taken for the benchmark system for building energy efficiency in Japan.

	Energy Intensity	Actual / average of the group	Energy Saving ratio
		Statistical study	By simulation tool
Applied categories of buildings	Convenient stores Shopping Center	hotels, department stores, food supermarkets	Tenant office
Reasons for application	Small variation on the feature of buildings	Many parameters correlate with energy consumption	Varies widely due to variation of tenants

Source : METI website

Introduction of Benchmark System to the Convenience Store Buildings (already enforced)

■Target Business

Japan Standard Industrial Classification : Convenience store (5891)
A business that mainly retailing various kinds of items such as food and drink in a self-service system, the store size is small, and it operates all day or for many hours a day.

■Benchmarks

＊Using the intensity indices adopted in the "Commitment to a Low Carbon Society "

$$\text{Benchmark} = \frac{\text{Total electricity consumption at all branches (stores only) of the convenience store company(kWh)}}{\text{Total sales amount of all the branches (stores only) of the convenience store company (million yen)}}$$

※ The number of all branches of convenience store is the number of directly managed stores and affiliated stores.

■Level to Achieve

Level to Achieve：845kWh ／million yen

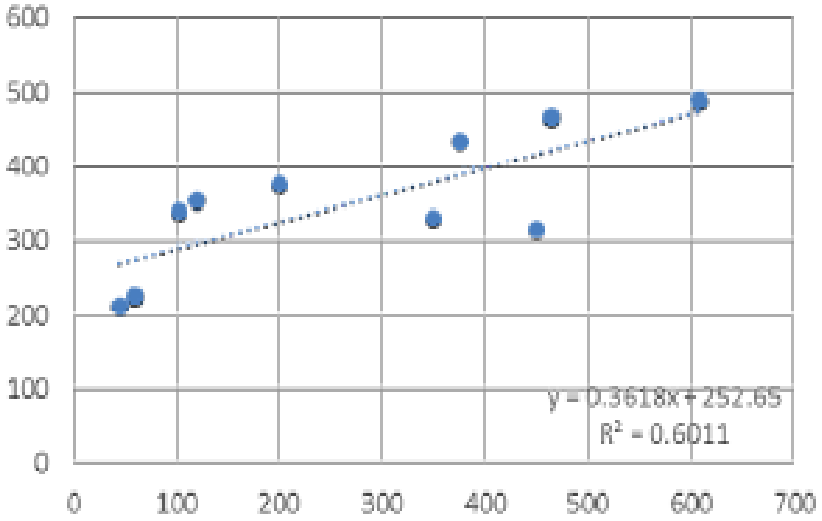
出典：経済産業省資料

Reference : Single Linear Regression Analysis

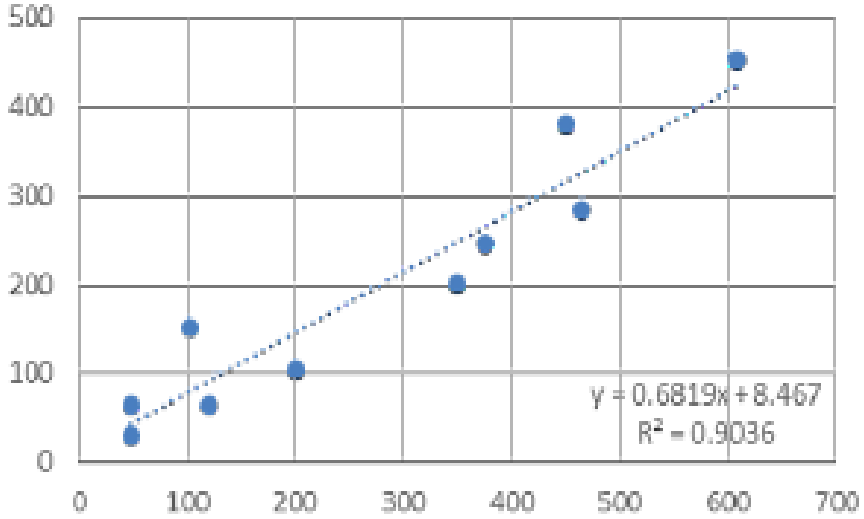
If Coefficient of determination (R^2) gets closer to 1.0, correlation between two items will become higher.

$$R^2 = \frac{\sum_{i=1}^{n}(\hat{y}_i - \bar{y})^2}{\sum_{i=1}^{n}(y_i - \bar{y})^2} = 1 - \frac{\sum_{i=1}^{n}(y_i - \hat{y}_i)^2}{\sum_{i=1}^{n}(y_i - \bar{y})^2}$$

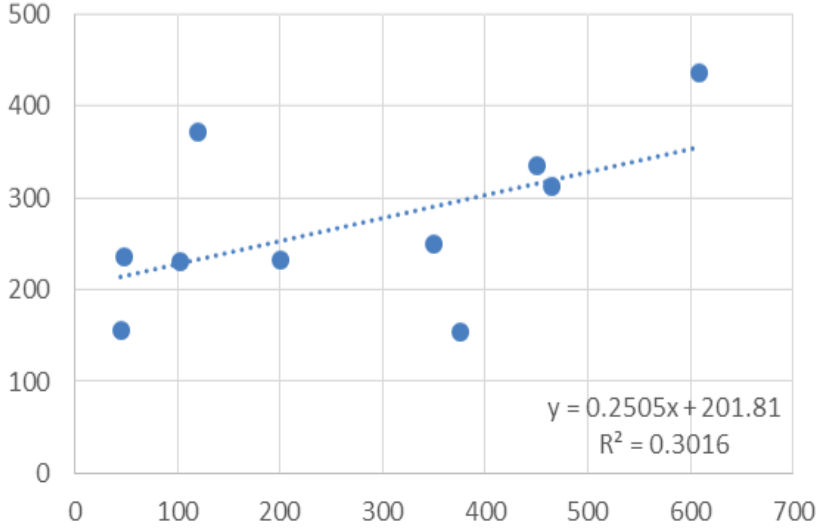
2. Coefficient of determination (R^2) : 0.6011



1. Coefficient of determination (R^2) : 0.9036



3. Coefficient of determination (R^2) : 0.3016



Benchmark standard for Hotels & Department store (under study)

■ Benchmark Index

Hotel

Actual Energy Consumption(GJ)

Estimated energy consumption calculated by multiple regression analysis(GJ)

(1) scale factor			(2) Service factor		(3)Operation factor	
FA: guest rooms (m2) × 2.238	FA: restaurant/ ballrooms (m2) × 6.060	FA : Indoor parking (m2) × 0.831	Accommodation capacity (nop) × −48.241	Emplo−yees (nop) × 32.745	Guests (lodging) (nop/yr) × 0.152	Gests (restaurant /Ballroom) (nop/yr) × 0.030

＋ ＋ ＋ ＋ ＋ ＋

Department Store

Actual Energy Consumption(GJ)

Estimated energy consumption calculated by multiple regression analysis(GJ)

(1) Scale factor		(2) Operation factor
Total floor area (m2) × 0.0531	＋	Annual sales amount (mill. yen) × 0.0256

Note: FA→Floor Area
nop→number of people

■Target Standard

Target benchmark	Number of samples (hotels)	Number of hotels achieved	Achieved
0.723	188	28	14.9%

■Target standard

Target benchmark	Number of samples (D. stores)	Number of D. stores achieved	Achieved
0.792	59	9	15.3%

Source：METI website

Expansion of Business Types as Target of Benchmark System (now being studied)

■ Benchmark index

Food supermarket business

Actual energy use (GJ)

Estimated energy use calculated with multiple regression equation (GJ)

(1) Scale factor		(2) Operational factor		(3) Equipment factor
Total floor area (m^2) x 2.214	+	Business hours of directly owned stores (hours) x 0.612	+	Cooling case measurement (pieces) x 5.884

Shopping center business

$$\frac{\text{Yearly total energy consumption of all stores (kl)}}{\sum\left(\text{Total floor area } (m^2) \times \text{Yearly business hours (h)}\right)}$$

■ Level to be aimed at

Now being studied

■ Level to be aimed at

Now being studied

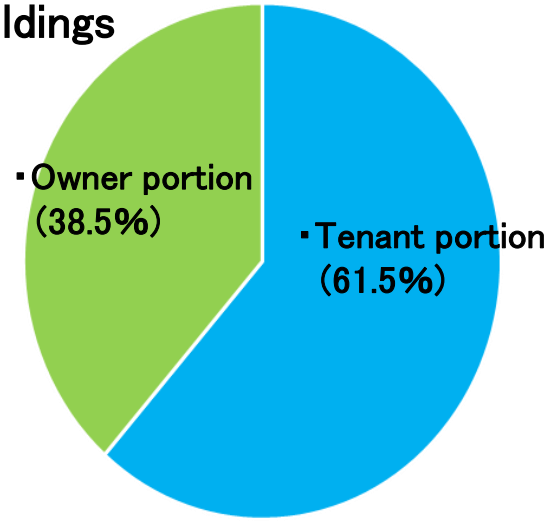
Source: Data of Ministry of Economy, Trade and Industry

Benchmark Standard for Offices (Under study)

Rental Office

The energy consumption of office buildings vary significantly according to the busines activities of the individual tenants

- The energy consumption of tenant office buildings share 62 % of the one of office buildings



- Difference is ten times depending on the business activities

Comparison between the energy consumption of each tenant in the same building in Marunouchi district in Tokyo (Mitsubishi Real Estate)

Expansion of Business Types as Target of Benchmark System (now being studied)

Lease office business

As a result of introduction of the energy conservation potential estimation tool, the following problems were found. (questionnaire)

[Problem 1] Input work is burdensome. → Improvement of the tool was studied.

- Input items are so many that priority must be put only on necessary items.
- It is difficult to read input items from drawings and becomes necessary to confirm them with design or construction companies.
- It is desirable to reduce items individually input, such as by using standard values.

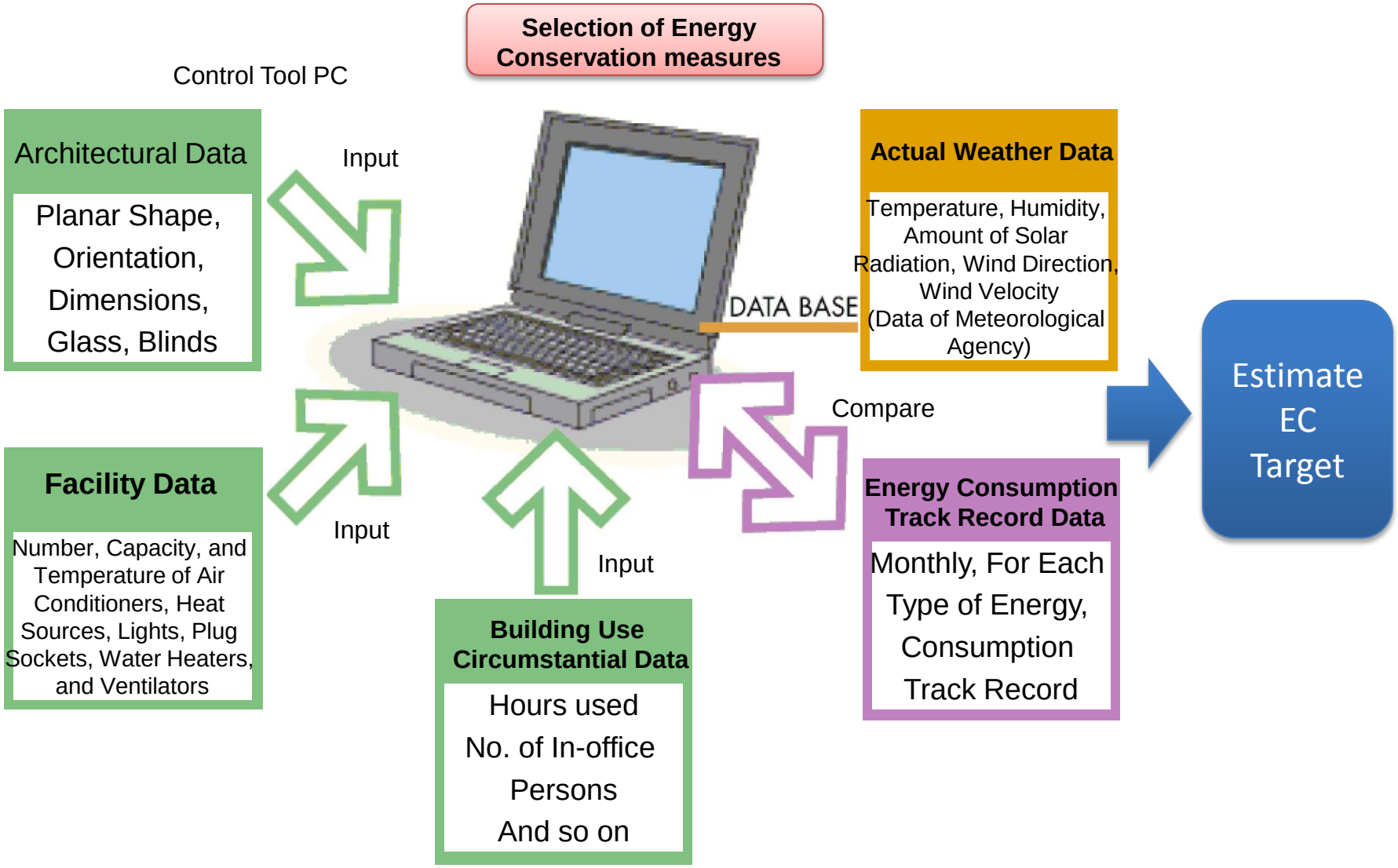
[Problem 2] It is difficult to obtain information on tenants → Improvement of the tool was studied.

- It is impossible to understand as far as the change of the layout of tenants. It is necessary to review contracts.
- It is difficult to know business days, business hours, air conditioning hours, and temperature settings of tenants.
- As there are many tenants in large-scale buildings, it takes a long time to collect information.

❑ Improvement effect was verified for the main building of the Ministry of Economy, Trade and Industry. As a result, it was found that the input time was reduced from 12 hours to 5.6 hours (54% reduction).

Source: Data of Ministry of Economy, Trade and Industry

Use of Energy Consumption Target Tool (ECTT/ECCJ)



Contents of Energy Conservation Measure Menu (57 Items)

Select from (1) measures taken, (2) no measures taken and (3) equipment not applicable and input the findings in the fields of the current state and the target of a building as a whole.

No.	Equipment type	Category	Name	Contents	Current	Target
1	Air conditioner	I. Operational measure	Cooling setting temperature easing	Cooling setting temperature is eased within the range that does not impair comfort of people using the building.		○
:			:	:		
16		II. Minor renovation	Introduction of total heat exchanger	By introducing total heat exchangers (including outdoor air processor with total heat exchanger function capable of dehumidification and humidification), heat load of outdoor air is reduced.	○	○
:			:	:		

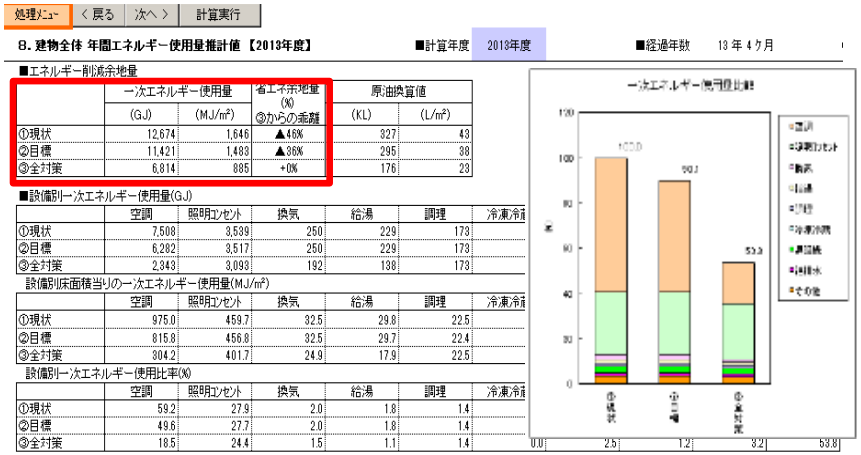
Source: Data of the Energy Conservation Center, Japan

Output Screen (Calculation Result)

・Using primary energy consumption estimated if all of 57 energy conservation measures are implemented as a reference, how much energy conservation potential can be expected between the current state and the target is displayed.

	Primary energy use		Energy conservation potential (%) Deviation from (3)
	(GJ)	(MJ/m²)	
(1) Current	12,674	1,646	▲46%
(2) Target	11,421	1,483	▲36%
(3) All measures	6,814	885	±0%

Energy conservation potential


処理ﾒﾆｭｰ | ＜戻る | 次へ＞ | 計算実行

8. 建物全体 年間エネルギー使用量推計値 【2013年度】 ■計算年度 2013年度 ■経過年数 13 年 4 ヶ月

■エネルギー削減余地量

	一次エネルギー使用量 (GJ)	一次エネルギー使用量 (MJ/m²)	省エネ余地量 (%) ③からの乖離	原油換算値 (KL)	原油換算値 (L/m²)
①現状	12,674	1,646	▲46%	327	43
②目標	11,421	1,483	▲36%	295	38
③全対策	6,814	885	+0%	176	23

■設備別一次エネルギー使用量(GJ)

	空調	照明コンセント	換気	給湯	調理	冷凍冷蔵
①現状	7,508	3,539	250	229	173	
②目標	6,282	3,517	250	229	173	
③全対策	2,343	3,093	192	138	173	

設備別床面積当りの一次エネルギー使用量(MJ/m²)

	空調	照明コンセント	換気	給湯	調理	冷凍冷蔵
①現状	975.0	459.7	32.5	29.8	22.5	
②目標	815.8	456.8	32.5	29.7	22.4	
③全対策	304.2	401.7	24.9	17.9	22.5	

設備別一次エネルギー使用比率(%)

	空調	照明コンセント	換気	給湯	調理	冷凍冷蔵
①現状	59.2	27.9	2.0	1.8	1.4	
②目標	49.6	27.7	2.0	1.8	1.4	
③全対策	18.5	24.4	1.5	1.1	1.4	

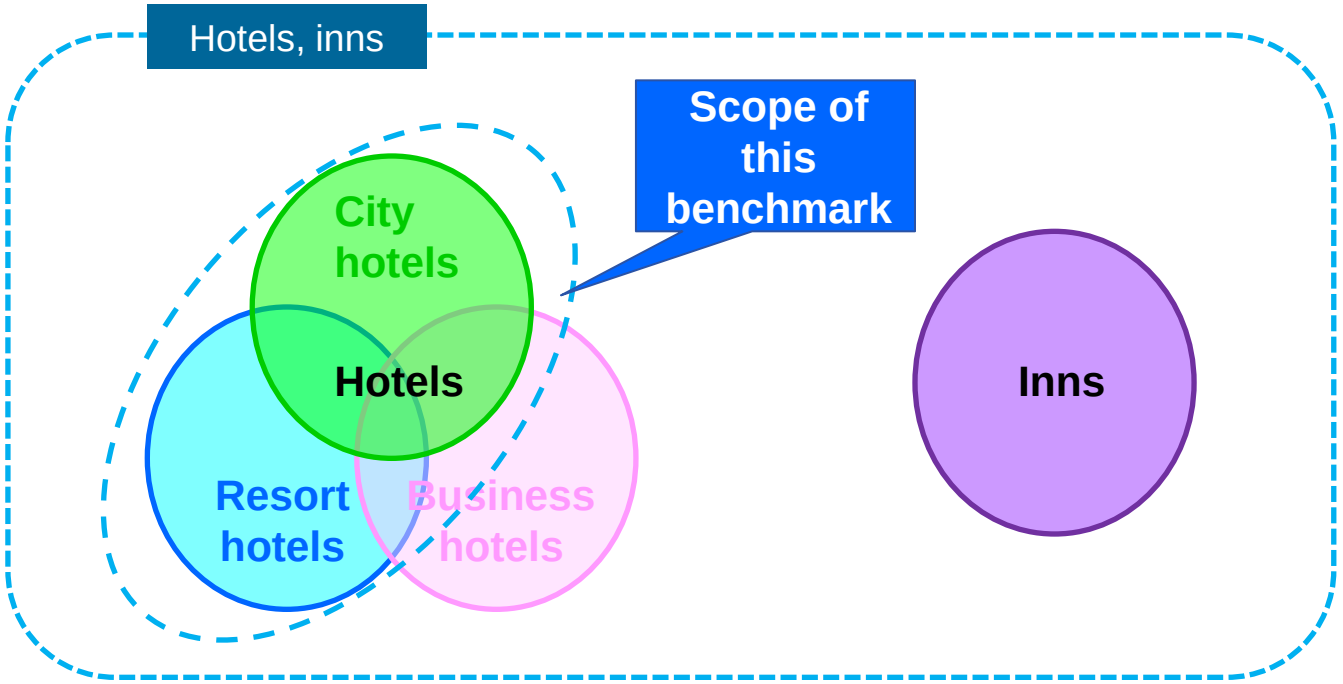
一次エネルギー使用量比較

Source: Data of the Energy Conservation Center, Japan

3.3 Benchmark Standard for Hotels

Target Scope of This Benchmark

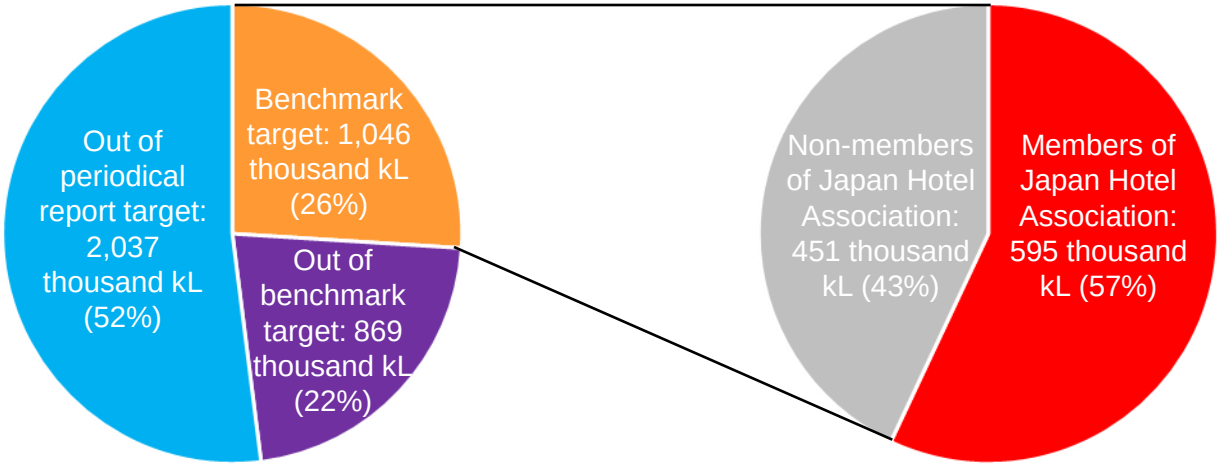
Hotel business is classified into city hotels, resort hotels and business hotels. Meanwhile, hotels joining in Japan Hotel Association as the target of this study are classified into city hotels or resort hotels.



Source: Data of Japan Hotel Association

Coverage Ratio of This Study Target

- Of the hotels and inns nationwide, the energy consumption ratio of business operators as target of this benchmark system accounts for 26%.
- As regards 22% excluded out of this benchmark study, the way to include them in the expansion of the target business type is studied hereafter.



Total of hotels and inns of the country: 3,952 thousand kL
(Hotels: 9,879, inns: 41,899)

Benchmark target: City hotels, resort hotels
Out of benchmark target: Business hotels, inns

Source: Data of Japan Hotel Association

Viewpoint and Policy for Studying Benchmark Index

- In order to objectively assess the energy conservation among business operators by using a common index, the following 4 conditions become necessary.

	Viewpoint	Policy
1	Make sure that the benchmark assessment does not become advantageous or disadvantageous due to fluctuation of the operational ratio.	As elements to be included in the equation, prioritize operational factors (number of guests staying, number of guests using food, beverage and banquet service, operational ratio of guest rooms, etc.)
2	The benchmark index shall be easily calculated by business operators.	Factors that are likely to impose excessive burden on business operators such as collecting information shall be excluded out of candidates (e.g. area of backyards of restaurants and banquet halls, capacity and quantity of energy-consuming equipment, etc.).
3	Equations are intuitively understandable.	Avoid complicated equations and use understandable ones (e.g. do not use those including logs, roots, etc.).
4	Should be appropriate as a statistic index.	Include those in the candidates, whose level of decision-making coefficients, t values, etc. are generally thought to be appropriate.

Source: Data of Japan Hotel Association

Features of Energy Consumption of Hotels

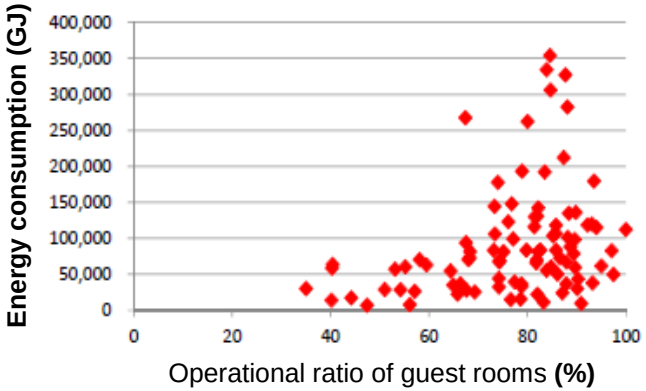
●Energy density is greater at food, beverage and banquet sectors than that at accommodation and common-use sectors.
●As the operational ratio increases, energy consumption becomes greater.
●Main energy consumption of indoor parking spaces is only lighting and ventilation and energy density there is considerably small compared with other sectors.

■Energy consumption intensity by sector

Target sector	Average intensity (GJ/m^2)
All sectors	2.7
Accommodation and common-use sector	2.0
Food, beverage and banquet sector	8.3

* All sectors = Accommodation and common-use sector + Food, beverage and banquet sector
* Food, beverage and banquet sector includes backyards of kitchens, etc.

■Energy consumption and operational ratio of guest rooms



Source: Data of Japan Hotel Association

Selection of Explanatory Variable

●The energy consumption of hotels is decided by the usage, capacity, quantity, etc. of energy-consuming equipment which the hotels own. However, it is difficult to know them all.

●Therefore, the following factors were made to be candidates of the elements used in the multiple regression equation as they are thought to have high relativity with the foregoing factors and their questionnaire data can be used (see the table below).

Factors	Explanatory variable	Coefficient of relativity with energy consumption
(1) Scale factor (m^2)	Accommodation and common-use sector area (m^2)	0.916
	Restaurant and banquet hall area (m^2)	0.703
	Indoor parking space area (m^2)	0.715
(2) Service factor (people)	Employees (people)	0.900
	Number of people accommodated (people)	0.759
(3) Operational factor (people)	Number of guests staying (people) *Yearly total	0.683
	Number of guests using food, beverage and banquet service (people) *Yearly total	0.835

*The accommodation and common-use sector area (m^2) said in (1) above is calculated with the following equation by using questionnaire data.
Accommodation and common-use sector area = Total floor area - (Indoor parking space area + Restaurant area + Banquet hall area)

Source: Data of Japan Hotel Association

Setting of Benchmark Index

・The denominator expresses the average value of equivalent hotels forecast by using a multiple regression equation. If the index is smaller than 1, the hotel is judged to be advanced in energy conservation.

<Example of calculation of benchmark index (draft)>

A value smaller than 1 means that the energy consumption is smaller than that of average hotels

Benchmark index of Hotel A = **Actual energy consumption of Hotel A (GJ)** / Average energy consumption (GJ) of hotels having the same scale, service, and operational state as Hotel A = ●.●●●

<Multiple regression equation>

Scale factor			Service factor		Operational factor	
Accommodation and common-use sector area of Hotel A (m^2) x 2.238	+ Restaurant and banquet hall area of Hotel A (m^2) x 6.060	+ Indoor parking space area of Hotel A (m^2) x 0.831	+ Number of people accommodated in Hotel A (people) x -48.241	+ Number of employees at Hotel A (people) x 32.745	+ Number of guests staying in Hotel A (people/year) x 0.152	+ Number of guests using food, beverage and banquet service at Hotel A (people/year) x 0.030

*** The foregoing is calculated using energy consumption data of member hotels of Japan Hotel Association.**

(Note) The decision coefficient of the above-mentioned forecast equation is 0.893, which has sufficient forecast accuracy.

Source: Data of Japan Hotel Association

Setting of the Level to be aimed at

<Idea of Agency for Natural Resources and Energy>
The level to be aimed at by the hotel industry shall be calculated by the same method as that used when the factory, etc. EC guideline WG reviewed the level to be aimed at by the industrial sector last year.

- **Use of multiple year data (to exclude specific nature of each year)**
  The data used shall be the value of the benchmark indices of 4 years in the past from 2012 to 2015 after the Great Earthquake.
- **Top 15% level**
  The benchmark index values calculated for each business operator are placed from the top in the descending order and the top 15% is made to be the level to be aimed at.

	Level to be aimed at	Number of sample business operators	Number of business operators who achieved the level	Achievement ratio
Hotel industry	0.723	188	28	14.9%

Source: Data of Japan Hotel Association

Method for Calculating Benchmark Index Values of Business Operators

・In case of a business operator owning multiple target hotels, values obtained by weighted average shall be the value for the business operator as shown in the following calculation example.

Calculation example

Hotel A	Hotel B	Hotel C
Energy use: 60,000GJ (1,548kl)	Energy use: 80,000GJ (2,064kl)	Energy use: 40,000GJ (1,032kl)
BM index value: 0.912	BM index value: 0.751	BM index value: 1.062

Benchmark index value of the business operator

$$= \frac{(60{,}000\text{GJ} \times 0.912 + 80{,}000\text{GJ} \times 0.751 + 40{,}000\text{GJ} \times 1.062)}{(60{,}000\text{GJ} + 80{,}000\text{GJ} + 40{,}000\text{GJ})} = 0.874$$

Source: Data of Japan Hotel Association

Summary (Benchmark System)

- The benchmark System in the industrial sector

(1) As it is difficult to maintain 1% reduction of energy consumption intensity in yearly average, the “benchmark system” is studied and introduced as a new assessment index.

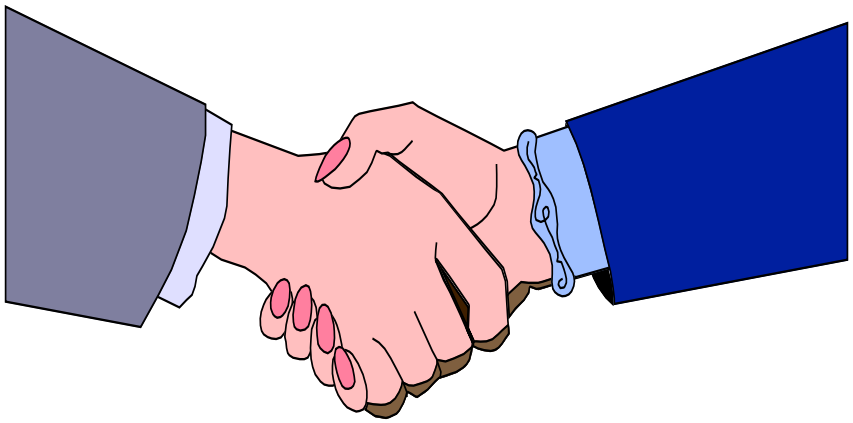
(2) In industries where energy conservation measures are well implemented (e.g. steel industry and electric utility industry), the achievement of the “benchmark index” has become difficult.

- Expansion of application of the "benchmark system" to the commercial sector.

(1) In the first phase, the application is expanded to 6 business types (convenience stores, hotels, supermarkets, department stores, lease offices and shopping centers). In the second phase, the application is further expanded to restaurants, schools, hospitals, amusement centers and others.

(2) Various types of the benchmark values according to the types of buildings has been studied and become the EE&C standard in Commercial Sector

Thank You Very Much



SMART CLOVER

ECCJ is promoting "Four Leaf Clover ", which is considered to bring happiness, as "SMART CLOVER", the symbol of the persons who implement EE&C .

The Energy Conservation Center, Japan

URL: http://www.eccj.or.jp