Energy Conservation Benchmark Standard in Commercial Sector

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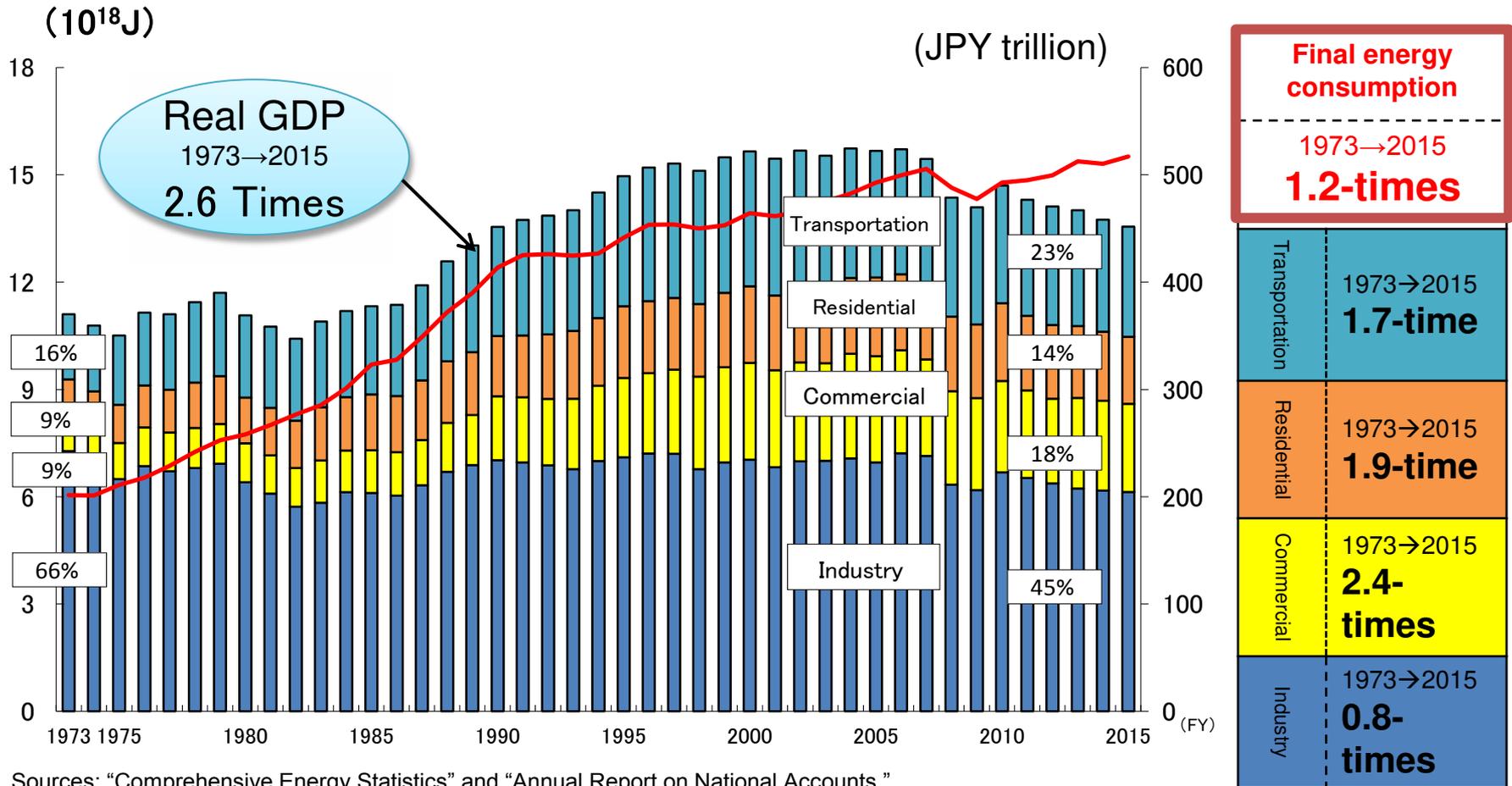
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Contents

1. Introduction

Trends in Final Energy Consumption in Japan

The final energy consumption of Japan has <u>basically consistently increased</u>, except for periods immediately following the two oil crises and the recent economic downturn.

$(10^{18}J)$

(JPY trillion)

Real GDP
1973→2015
2.6 Times

Transportation
23%

Residential
14%

Commercial
18%

Industry
45%

16%
9%
9%
66%

Final energy consumption

1973→2015
1.2-times

Transportation	1973→2015 **1.7-time**
Residential	1973→2015 **1.9-time**
Commercial	1973→2015 **2.4-times**
Industry	1973→2015 **0.8-times**

1973 1975　1980　1985　1990　1995　2000　2005　2010　2015 (FY)

Sources: "Comprehensive Energy Statistics" and "Annual Report on National Accounts."

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Need for Further Improvement of Energy Efficiency

- Thorough energy conservation measures could save final energy demand by 13% to 326 million kl in consideration of economic growth 1.7% per year.
- Energy conservation measures would be accumulated to improve energy efficiency as much as just after the oil crises.

【Improvement in Energy Intensity】

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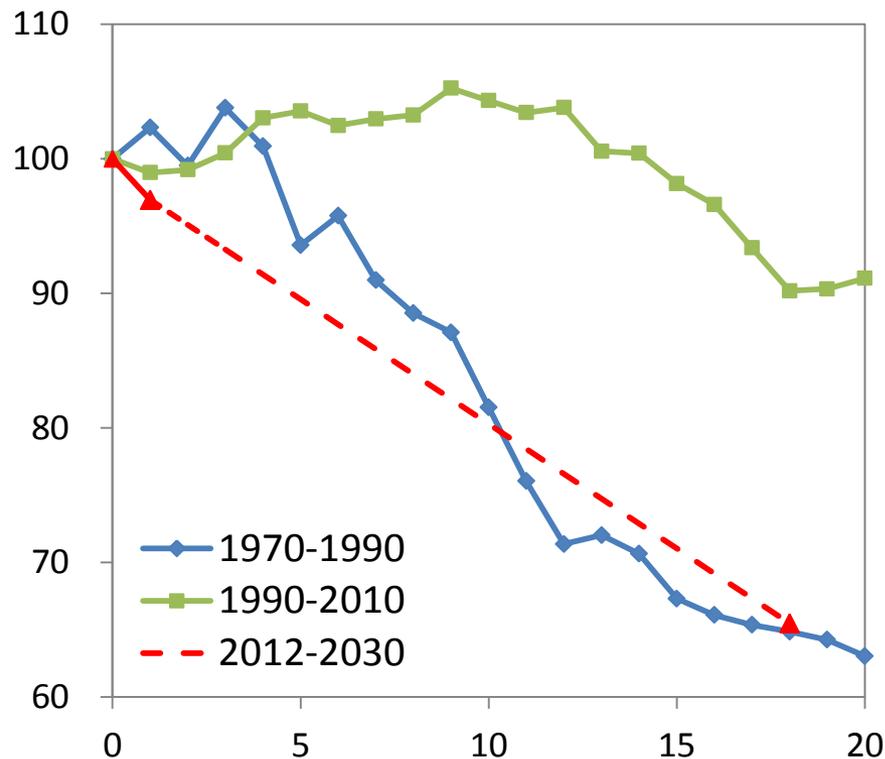
"Energy Innovation Strategy" by METI in 2016

Thorough Energy Efficiency & Conservation

(Target to 2030)
EE&C :Energy intensity improve:
▲35%

Industry Sector

- **Expand EE&C Benchmark System**
  To distribution & service businesses
  Strict benchmark standards
- **Promote EE&C in S&M enterprises**
  Local consulting platform
  EE&C mutual supporting system
- **New evaluation system for business operator classification on EE&C**
  Develop the classification system
  Create unused heat utilization system

Building & Residence Sectors

- **Promotion of introduction of energy saving equipment**
  Top Runner standard of lamps
- **Promotion of EE&C on houses/buildings**
  Mandatory standards of BEC (for design)
  Promote Zero Energy houses/buildings
  Promote renovation for EE&C

Transportation sector

- **Dissemination of next-generation vehicles**
  Initial demand &Infrastructure
- **Promotion of the automatic driving**

Expansion of Renewable Energy

RE: 22 to 24% of total power supply

Suppression of the Public Burden and Maximum Introduction

- Overall refinement of the FIT (Feed-in Tarif) and the related system

- Responding to review and non-operation projects of the certification system

- How to promote a stable, long-term power generation

- Introduction of cost-efficient system

- Expanded introduction of long power lead time

- Promotion of introduction that take advantage of the power system

Development of New Energy System

- Activate Electricity retail market
- Generation efficiency up to: 0.3kg-CO_2/kWh

New business

- Drastic improvement of incentives for power saving
- Technology demonstration of "virtual power plant"
- Promoting overseas development with a focus on developing countries

Compatibility of the New entry and reduction of CO2 emissions

- Ensure the "effectiveness" and the "transparency" in voluntary framework

Initiatives looking forward to 2030 and beyond

- Realization of "Hydrogen Society"

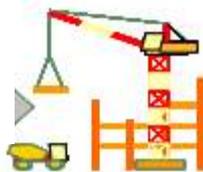Promotion and dissemination of of the ENE-FARM, FCV

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2. Evaluation system for business operator classification Obligation of the Building Owners under the EC Law

| Design | Construction | Operation | Renovation |

For Design and Maintenance

Buildings having total floor area 300 m2 or larger

Before construction 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)

After operation start

Submission of periodical maintenance report to the competent authority (local government)

Submission of the notification of energy saving measures to the competent authority (local government) before extensive renovation

Implemented by MLIT the Local Government

For Operation

**Specified Business Operator designated 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.**
- **Compliance to EC Guideline**

Implemented by METI

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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

Practical guideline to support Energy management

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

Registered Energy Manager

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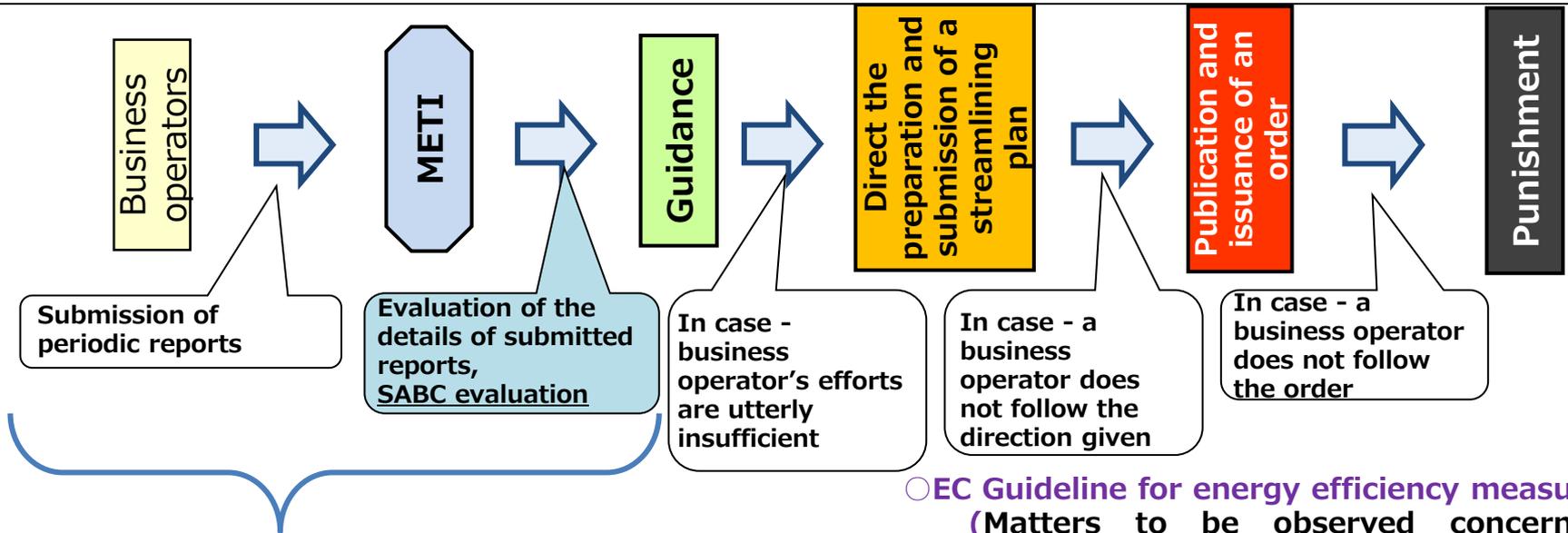- Carrying out "Energy Audit"

·Instruction
·Technical Advice

Engineers (Middle Management)

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Report to METI on energy efficiency activities

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

Business operators → METI → Guidance → Direct the preparation and submission of a streamlining plan → Publication and issuance of an order → Punishment

Submission of periodic reports

Evaluation of the details of submitted reports, SABC evaluation

In case - business operator's efforts are utterly insufficient

In case - a business operator does not follow the direction given

In case - a business operator does not follow the order

< **Matters to be stated in periodic reports** >
- **Implementation status of energy conservation measures**
- **Changes in energy intensity**
- **Status of the benchmark indices (for only applicable types of business)**

○**EC Guideline 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)**

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Business operators classification system on EE&C

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 Industry and Commercial Sectors

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%

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3. EE&C Benchmark system in Japan
Current State of Energy Conservation in Japan

As far as the change of the energy 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

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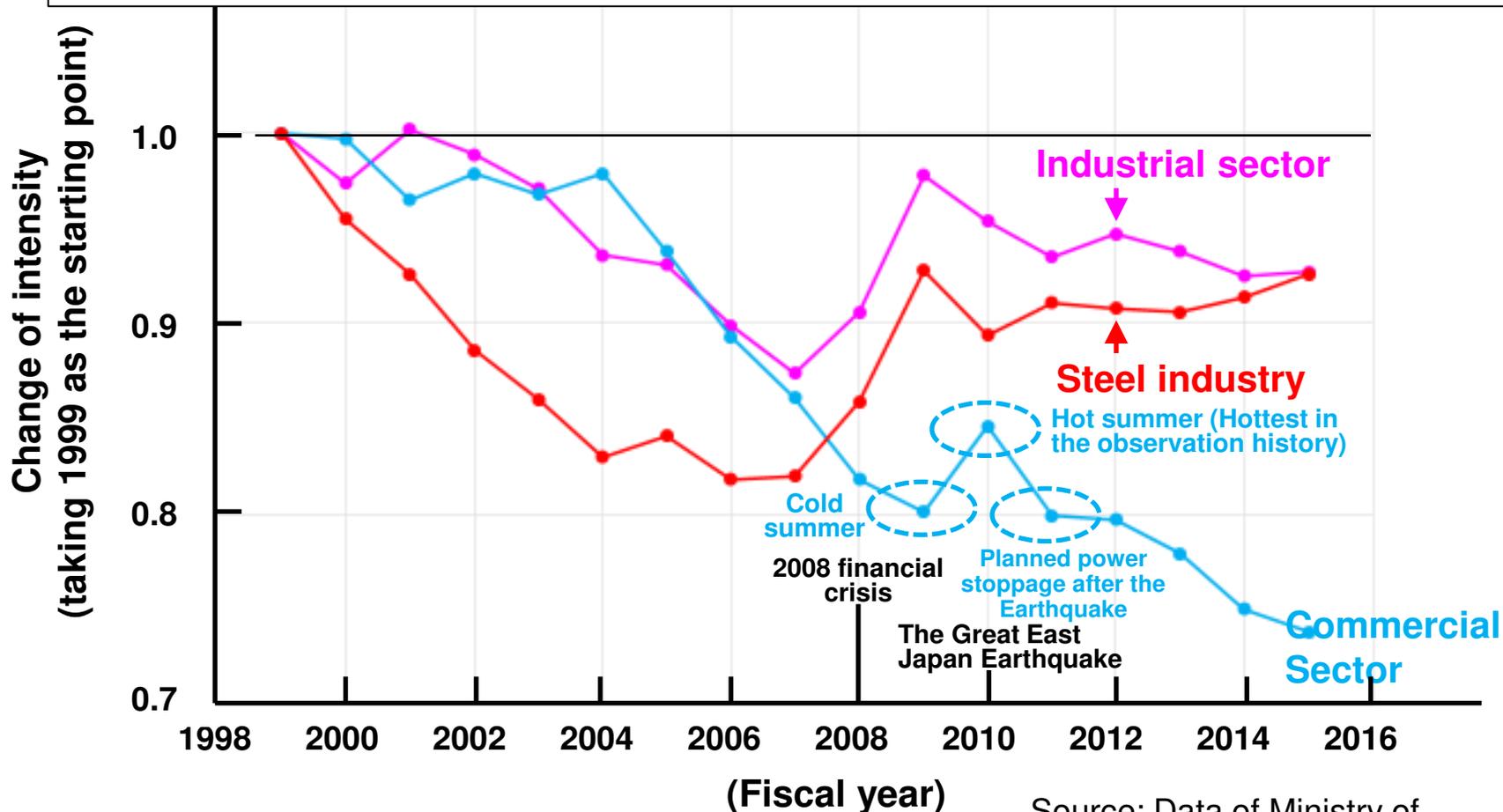
Development of Benchmark System in Commercial Sector

- 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 able to be not assessed appropriately:

2008: Benchmark system studies to establish a new assessment index for EE&C stated.

2009-2010: Benchmark system was introduced Industry sector
Six business types (10 fields)

2014: Studies on benchmark system for the commercial sector started (Six (6) business types)
2015: Prime Minister Abe instructed the committee to expand the benchmark target business in the commercial sector.

2016: Benchmark system was introduced first **to convenience stores** business.
2017: Introduced to **Hotel and department store**
2018: Introduced **to Food Super Markets, Shopping centers and Rental Offices**
2019: will be introduced to **Universities**

Source: Data of Ministry of Economy, Trade and Industry

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Targeted business types to apply Benchmark System

● Benchmark System has been introduced in the following 6 business types (10 fields) in industry and 6 business types in commercial sector

Industry sector:
6 business types (10 fields) were chosen.
(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

Commercial sector：
<6 business types >
6 business types were chosen.
(1) Convenience store
(2) Hotel
(3) Department store
(4) Lease office
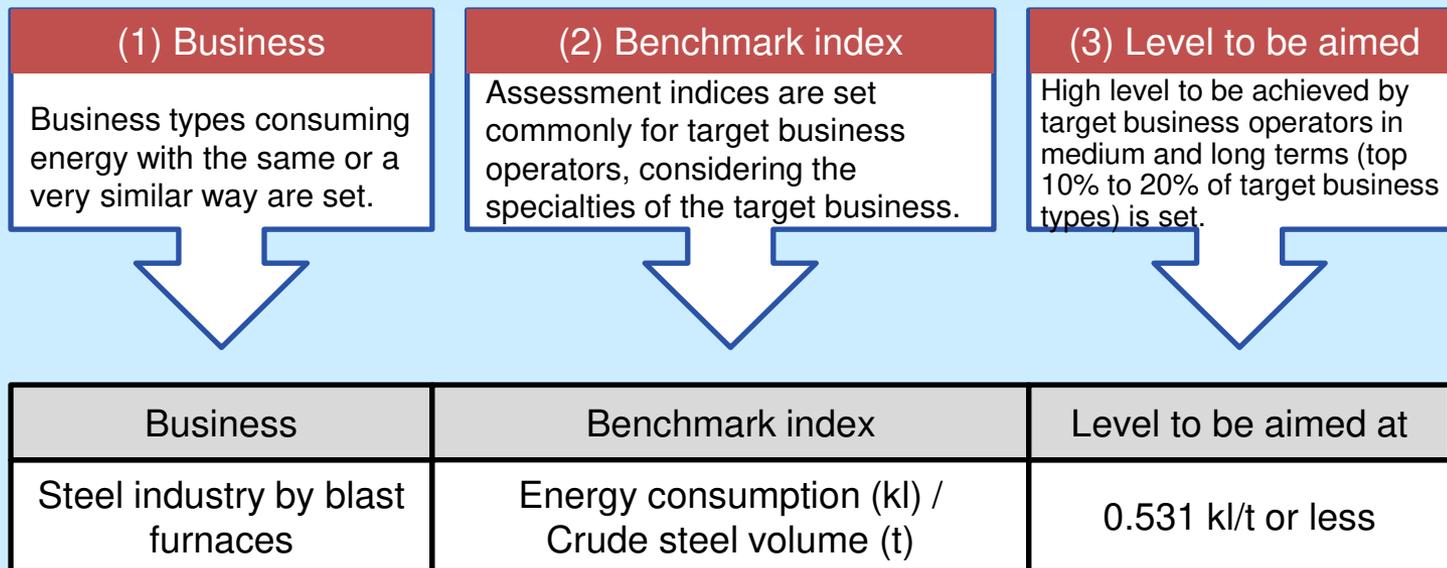(5) Supermarket
(6) Shopping center

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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.
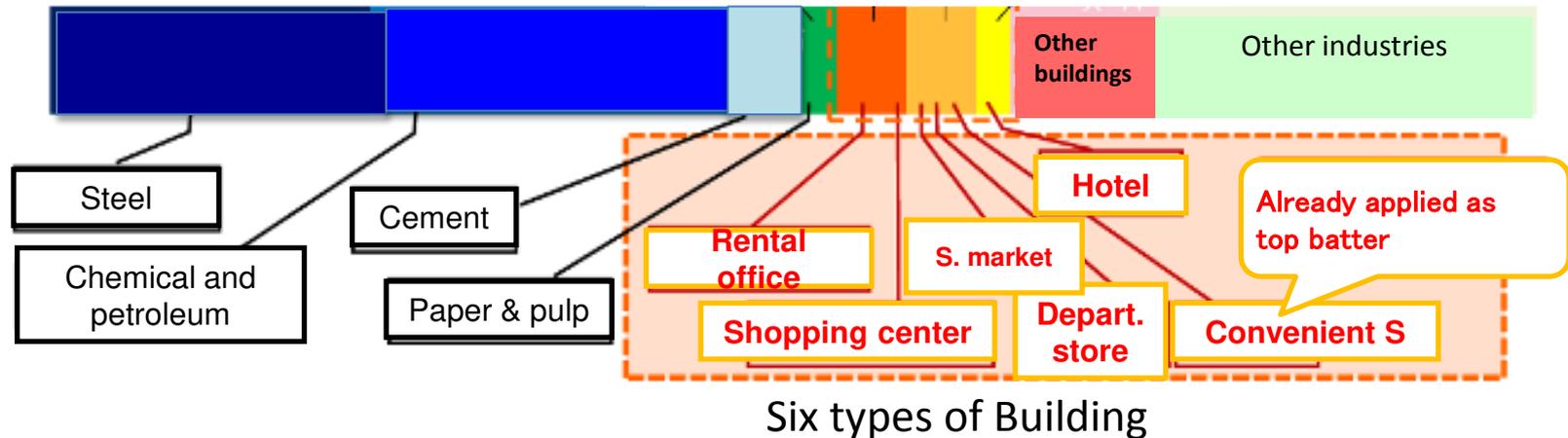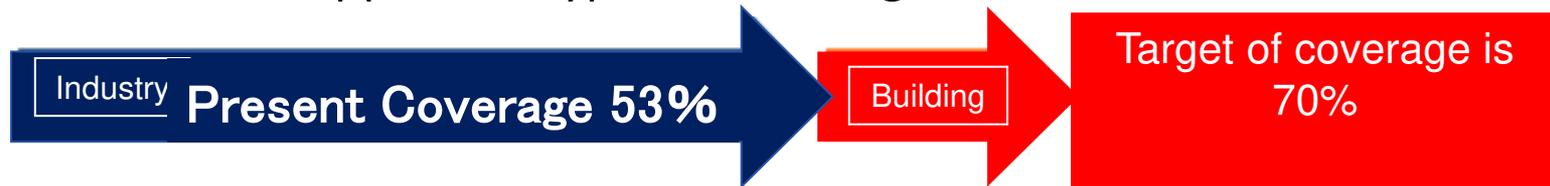
3 elements necessary for the establishment of the benchmark system

(1) Business

Business types consuming energy with the same or a very similar way are set.

(2) Benchmark index

Assessment indices are set commonly for target business operators, considering the specialties of the target business.

(3) Level to be aimed

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

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Expansion of the Coverage of EE&C Benchmark System to 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

Industry **Present Coverage 53%** → Building → Target of coverage is 70%

Steel

Chemical and petroleum

Cement

Paper & pulp

Rental office

Shopping center

S. market

Depart. store

Hotel

Convenient S

Already applied as top batter

Other buildings

Other industries

Six types of Building

Source: Data of Ministry of Economy, Trade and Industry

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4. Introduction of Benchmark Standard In Commercial Sector

- ❑ Basically, building benchmark index is the value calculated by dividing the energy consumption of that building by the average energy consumption of the buildings in the business category which that building belongs to.
- ❑ The standard level is determined based on that 10%-20% of the buildings in the category can satisfy such level.
- ❑ The parameters correlated with energy consumption are different according to the type of buildings.
- ❑ 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

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Enforced Benchmark Standard in Commercial sector

The benchmark system has been introduced in 13 sectors in nine industries so far, but since the food supermarket business, the shopping center business and the rental office business were added from April 2018, the target was 12 sectors and 16 industries.

Type of buildings	Benchmark Definition	Benchmark
Convenient Store (2016)	The value obtained by dividing the total electricity consumption in the stores conducting the business by the total amount of sales at the stores concerned	≦845kWh／mill.¥ Energy Intensity
Hotel **(2017)**	The value obtained by dividing the actual energy consumption for the hotel operation by the average energy consumption of the hotels with same scale, service, and operating status as that hotel	≦ 0.723 Statistical study
Department stores (2017)	The value obtained by dividing the actual energy consumption of the department store conducting the business by the average energy consumption of the department stores with same scale as that department store	≦0.792 Statistical study

Source: Data of Ministry of Economy, Trade and Industry

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Enforced Benchmark Standard in Commercial Sector

Type of Building	Benchmark Definition	Benchmark
Food Supermarket **(2018)**	The value obtained by dividing the actual energy consumption of the supermarket conducting the business by the average energy consumption of the supermarkets with same scale, operation status and equipment arrangement as that supermarket	≦0.799 Statistical study
Shopping Center (2018)	The value obtained by dividing the energy consumption at the facility conducting the operation by the total floor area	≦0.0305kl/㎡ Energy Intensity
Rental Office (2018)	There is room (%) for energy saving in operation at that office calculated by the energy saving potential estimation tool	≦16.3% Simulation tool

In the second phase, the application is further expanded to restaurants, schools, hospitals, amusement centers and others.

Source: Data of Ministry of Economy, Trade and Industry

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Introduction of Benchmark System to Convenience Stores (enforced 2016)

■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

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Introduction of Benchmark Standard to Hotels (enforced 2017)

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 occupation ratio increases, energy consumption becomes greater.
- Main energy consumption of indoor parking area 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-u sector + Food, beverage and banquet sector
* Food, beverage and banquet sector includes backyards of kitchens, etc.

■Energy consumption and operational ratio of guest rooms

Operational ratio of guest rooms **(%)**

Source: Data of Japan Hotel Association

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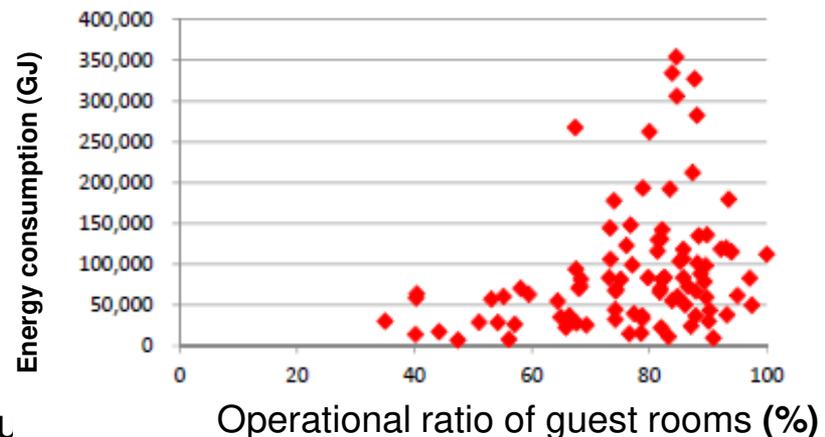
Reference : Single Linear Regression Analysis

If Coefficient of determination (R²) gets closer to 1.0, correlation between two items will become higher.

$$R^2 = \frac{\sum_{i=1}^{n}(\hat{y}_i - \overline{y})^2}{\sum_{i=1}^{n}(y_i - \overline{y})^2} = 1 - \frac{\sum_{i=1}^{n}(y_i - \hat{y}_i)^2}{\sum_{i=1}^{n}(y_i - \overline{y})^2}$$
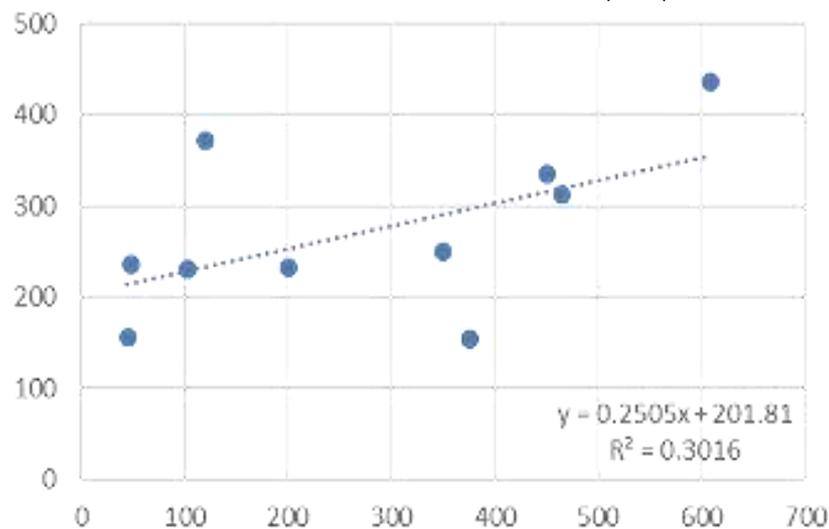
2. Coefficient of determination（R²）: 0.6011
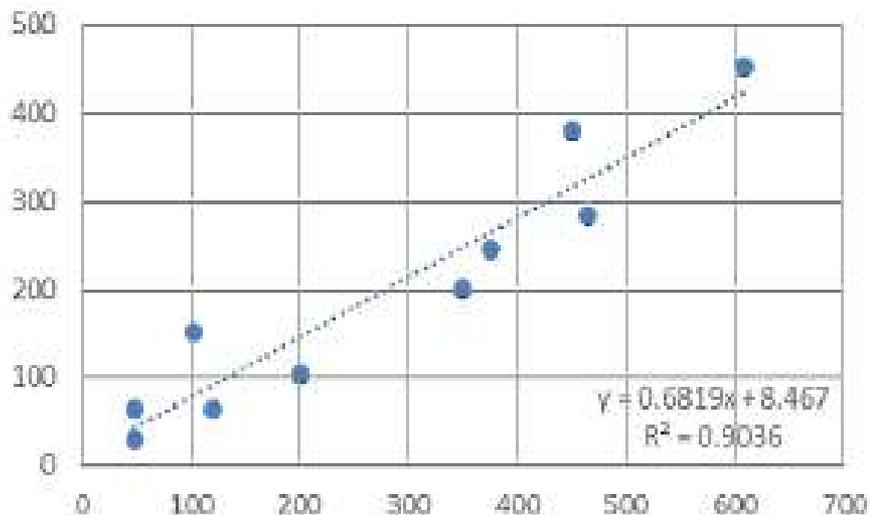
1. Coefficient of determination（R²）: 0.9036
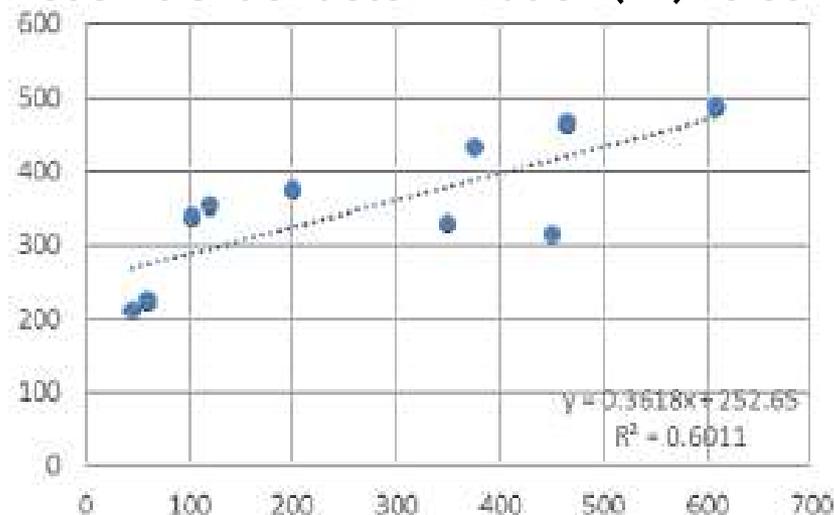
3. Coefficient of determination（R²）: 0.3016

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Selection of the Explanatory Variables

● 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 (m²)	Accommodation and common-use sector area (m²)	0.916
	Restaurant and banquet hall area (m²)	0.703
	Indoor parking space area (m²)	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 (m²) 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)

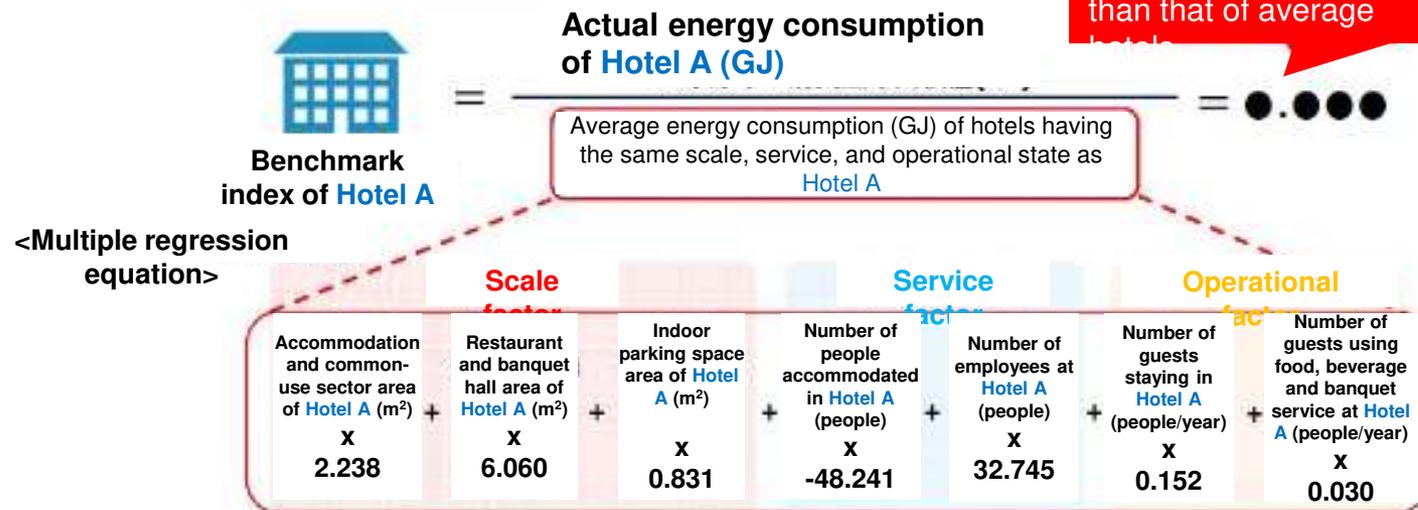Source: Data of Japan Hotel Association

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Setting of Benchmark Index

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

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

<Example of calculation of benchmark index (draft)>

Actual energy consumption of Hotel A (GJ)

Benchmark index of Hotel A =

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 (m²) x 2.238 | Restaurant and banquet hall area of Hotel A (m²) x 6.060 | Indoor parking space area of Hotel A (m²) 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.

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

Introduction of Benchmark Standard to Food Supermarkets (enforced in 2018)

The benchmark index for food supermarkets is a value obtained by dividing the actual value of the energy usage amount of the store by the average energy usage amount of the food supermarkets of the same scale, operation status, and equipment scale as the target store

Supermarket A

Benchmark index of SM A = $\dfrac{\text{Actual energy consumption (GJ)}}{\text{Average energy consumption of the SMs, similar size of SM A, calculated by the below (GJ)}}$ = 0.000

Total floor area of SM A (m²) x 2.543	+	Business hours of SM A (hours) x 0.684	+	Total sum of length of refrigeration cases of SM A x 5.133
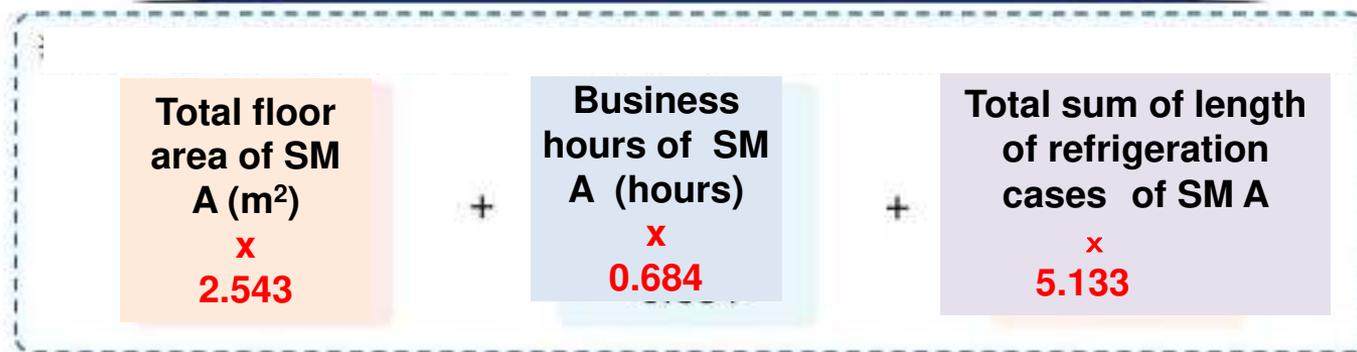
Target level

Not less than 0. 799（15% can achieve the target）

Source: Data of Ministry of Economy, Trade and Industry

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Introduction of Benchmark Standard to Rental Offices (enforced in 2018)

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

- **The energy consumption of tenant office buildings share 62 % of the one of office buildings**
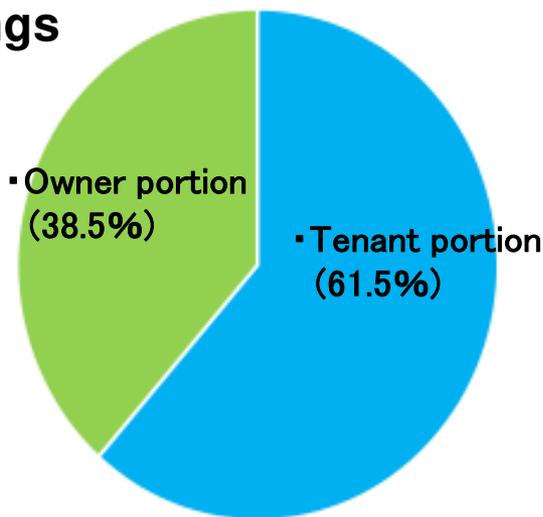
- **Difference is ten times depending on the business activities**

- Owner portion (38.5%)
- Tenant portion (61.5%)
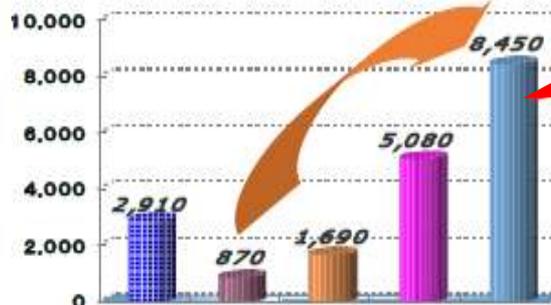
Max ten times

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

Source: Data of Ministry of Economy, Trade and Industry

Benchmark standard on Rental Offices

- Calculate energy consumption of the building using "Energy Saving Potential Estimation tool", and
- Input the building specifications, operating conditions, facilities, the implementation status of energy conservation countermeasures, etc. and calculate the potential for energy savings from the difference between the current situation and when all the applicable energy saving measures have been implemented.

Source: Data of Ministry of Economy, Trade and Industry

Energy Saving Potential Estimation tool

Use of Energy Consumption Target Tool (ECTT) developed by ECCJ)

Selection of Energy Conservation measures

Control Tool PC

Architectural Data

Planar Shape, Orientation, Dimensions, Glass, Blinds

Input

Actual Weather Data

Temperature, Humidity, Amount of Solar Radiation, Wind Direction, Wind Velocity (Data of Meteorological Agency)

DATA BASE
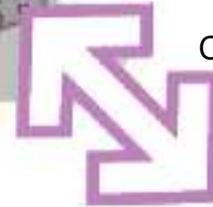
Facility Data

Number, Capacity, and Temperature of Air Conditioners, Heat Sources, Lights, Plug Sockets, Water Heaters, and Ventilators

Input

Compare

Building Use Circumstantial Data

Hours used No. of In-office Persons And so on

Input
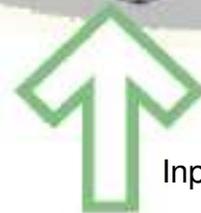
Energy Consumption Track Record Data

Monthly, For Each Type of Energy, Consumption Track Record

Estimate EC Target

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Contents of Energy Conservation Measure Menu (57 Items)

Select the answer from three choices (1) measures taken, (2) no measures taken and (3) equipment not applicable and input the answers in the boxes of columns of the current and the target stages .

No.	Equipment type	Category	Name	Contents	Cur-rent	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.		○
:			:	:		
1 6		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

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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/m^2)	
(1) Current	12,674	1,646	▲46%
(2) Target	11,421	1,483	▲36%
(3) All measures	6,814	885	±0%

Energy conservation potential

Source: Data of the Energy Conservation Center, Japan

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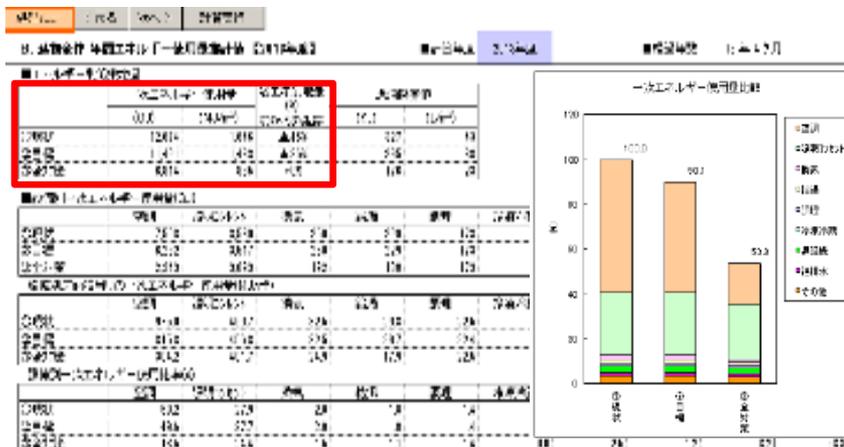
5. *Summary*

- In April 2016 METI has formulated an energy innovation strategy through the public-private dialogue based on the new strategic energy plan (2014) prepared after the 2011 Fukushima disaster, and has been implementing the measures based on it. Among those measures, I explained about the expansion of EE&C benchmark standard to the commercial sector and the related measures for EE&C promotion such as business operator classification system.

- In the first phase, "Benchmark Standard" has been expanded to 6 business types of the commercial sector (convenience stores (2016), hotels (2017), department stores(2017), food supermarkets (2018), rental offices (2018) and shopping centers(2018)). In the second phase, the application is further expanded to restaurants, schools, hospitals, amusement centers and others.

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